Building Research Establishment Report

BREEAM/Existing Offices

Version 4/93

An environmental assessment for existing office buildings

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Version 4 of BREEAM concerns existing office buildings; Version 1 covers new office design, Version 2 covers new superstores and supermarkets, and Version 3 covers new homes. This publication will be used as a basis for extensive consultation about future developments with relevant building professionals and environmentalists.

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1 Buildings and environmental issues

INTRODUCTION

Environmental issues are becoming increasingly important and there is an associated increase in public awareness. There is generally less awareness of the large impact buildings have on the environment and the scope for reducing this impact through good design, operation and maintenance.

The BRE Environmental Assessment Method (BREEAM) scheme was launched in 1990 to provide authoritative guidance on ways of minimising the adverse effects of buildings on the global and local environments while promoting a healthy and comfortable indoor environment. The basis of the scheme is a certificate awarded to individual buildings stating clearly the performance of the building measured against a set of criteria. 'Credits' are awarded where the building satisfies these criteria for a range of issues. The building is assessed independently by assessors appointed by BRE. BRE is responsible for specifying the criteria and methods of assessment used.

The present document describes the version of BREEAM which applies to existing office buildings. It adds to a series of BREEAM versions for offices, superstores and supermarkets, and homes, which are applicable only to new buildings and are assessed at the design stage[1,2,3].

The assessment method described here specifies criteria for a range of environmental issues in relation to the design, maintenance, operation and management of existing office buildings. Where these issues have been addressed and the criteria satisfied, the owners or occupants of the building are able to obtain recognition for this, in the form of credits on a certificate which, for example, can be displayed in the building or form part of an organisation's overall environmental statement.

The main objectives of the assessment method are:

- to provide market recognition for buildings where the environmental impact has been reduced;
- to encourage best practice in designing, operating and maintaining buildings;
- to set criteria and standards going beyond those required by law and regulations;
- to raise the awareness of owners, occupants, designers and operators of the adverse impact of buildings on the environment.

OPPORTUNITIES FOR USING BREEAM FOR EXISTING OFFICES

Buildings have a long life which runs into decades and sometimes into centuries. During the life of a typical office building, alterations, fit-outs and refurbishments are likely to be needed with extensive changes to the building's services and fabric. Changes in occupation will affect the way the building is managed and maintained. With each of these changes in design and use comes the opportunity for improving the environmental performances of the building. An environmental assessment can identify these improvements and provide recognition for them once they have been implemented.

BREEAM 4/93 can be applied at any time during the life of an existing building. Particular opportunities occur when:

- an existing office building is empty awaiting a new tenant;
- the existing management seeks to improve environmental performance;

- refurbishment and fit-out of the building or its services is being contemplated;

- an objective statement of the environmental performance is required.

The assessment will usually apply to a whole building. Where the building is let or is likely to be let to several occupiers, assessments may be carried out for an individual floor or floors of a building. Where this is done the area assessed will be clearly defined on the certificate.

When a major refurbishment is planned (ie when only the frame and facade remain) the use of BREEAM/New Offices: Version 1/93[1] may be appropriate.

ISSUES COVERED

The assessment is in two parts. The first part relates to the building fabric and building services, and the second part to the operation and management of the building. Most issues are covered in both parts but from a different point of view. An unoccupied building is only able to obtain Part 1 of the certificate. An occupied building is eligible for both Part 1 and Part 2 with the assessment undertaken as a single operation.

The purpose of the two-part certificate is to allow different groups to use the scheme. Thus a landlord or letting agent may use Part 1 in order to assure a prospective tenant that the building and its services meet good environmental standards. Parts 1 and 2 together may be used by occupier's facilities or accommodation managers, or others responsible for the building, to assess the environmental performance of their building and to assist in improving it.

Under each part of the assessment, criteria have been established against which the building design and the occupant's management policies can be compared. The environmental issues covered are grouped under three main headings:

- Global issues and use of resources
- Local issues
- Indoor issues

The issues and related criteria are described in the following sections and a summary of the issues is given in Table 1.

CRITERIA AND SCOPE

BREEAM 4/93 relates to the building's fabric, the building's services (space and water heating, ventilation, cooling and lighting) and the fittings (carpets, blinds, paper storage). It deliberately does not cover the furniture or the equipment and materials used by the occupants in carrying out their work. Thus it does not include the choice of photocopying machinery, the choice of recycled paper, the use of solvents, etc, except where the disposal of office products relates to the layout and use of space, for instance the provision of storage facilities for waste collection.

Credits will be given where satisfactory attention is paid to the issues described in the following sections of the report. Credit will only be given if the building has qualities over and above those legally required. Items have only been included where there is authoritative evidence that a real risk or benefit is involved. Attention is paid to factors which are at the forefront of current knowledge but have yet to become standard aspects of building operation, management or design. However, not all issues of concern have reached the stage where there is sufficient evidence for the setting of performance criteria and their assessment. A list of issues which cannot yet be included in this assessment but which could be included in future versions of the assessment, as knowledge increases, is given in Appendix A.

Table 1 Summary of credits covered

PART 1: Building fabric and services

GLOBAL ISSUES AND USE OF RESOURCES

Carbon dioxide emissions

* 1 credit for less than 120 points
* 2 credits for less than 110 points
* 3 credits for less than 100 points
* 4 credits for less than 90 points
* 5 credits for less than 80 points
* 6 credits for less than 70 points
* 7 credits for less than 60 points
* 8 credits for less than 50 points
* 9 credits for less than 40 points
* 10 credits for less than 35 points
* 1 credit for individual check meters for each tenant in multi-tenanted buildings
* 1 credit for adequate sub-metering for each tenant to enable energy monitoring

Acid rain

* 1 credit for low-NO_x-emitting boilers

Ozone depletion

* 1 credit for refrigerant ODP of less than 0.06 *or* no air conditioning
* 1 credit for refrigerant ODP of zero *or* no air conditioning
* 1 credit for a refrigerant leak detection system *or* no air conditioning
* 1 credit for on-site refrigerant recovery *or* no air conditioning
* 1 credit for avoiding halon-based fire protection

Recycling of materials

* 1 credit for separate storage facilities for recyclable materials

LOCAL ISSUES

Water conservation

* 1 credit for a building with two of the following:
  - water meter
  - WCs with maximum 6-litre flush
  - water economy devices on urinals
* 1 further credit for all three of the above

Legionnaires' disease

* 1 credit for no evaporative cooling towers or condensers

Transport

* 1 credit for access to good public transport
* 1 credit for two of the following features:
  - secure points for bicycles
  - secure points sheltered from rain
  - changing facilities for staff who cycle
  - facilities for hanging and drying wet clothes
  - showers for staff who cycle

INDOOR ISSUES

Lighting

* 1 credit for high-frequency ballasts fitted to luminaires

Air quality

* 1 credit for adjustable openable windows in each room or for mechanical ventilation where there is no visible free-standing water in the ductwork
* 1 credit for no humidification or for steam humidification
* 1 credit for an effective filtration system capable of removing pollen particles

Hazardous materials

* 1 credit for having carried out an asbestos survey and taking necessary action *or* where the building specification specifically excluded asbestos materials
* 1 credit for no visible lead pipes in drinking-water supply

Radon

* 1 credit for ensuring that radon levels do not exceed 200 Bq/m^3 *or* for buildings outside a high-risk area

Indoor noise

* 1 credit for noise levels below:
  - 45 dB $L_{Aeq,T}$ in small offices
  - 50 dB $L_{Aeq,T}$ in large offices

Legionnaires' disease

* 1 credit for buildings which have domesic hot water systems designed to avoid legionellosis

PART 2: Building operation and management

ENVIRONMENTAL POLICY

* 1 credit for having an established and openly available overall company policy on the environment
* 1 credit for a company purchasing policy which excludes the use of timber from unsustainable sources
* 1 credit for a company purchasing policy which excludes the use of other environmentally damaging materials

GLOBAL ISSUES AND USE OF RESOURCES

Carbon dioxide emissions

* 1 credit for having an energy policy endorsed by the board of directors, with a suitably trained member of staff to implement it
* 1 credit for an energy audit of the building
* 1 credit for an energy monitoring and targeting system
* 1 credit for an energy efficiency improvement investment budget in relation to refurbishment
* 1 credit for an operating manual for services
* 1 credit for regular dissemination of information on energy use and means of saving energy to services systems operators and occupants
* 1 credit for a regular system maintenance schedule

Ozone depletion

* 1 credit for regular inspection for refrigerant leaks or where no air conditioning is provided
* 1 credit for minimising unnecessary emissions of halon or where no halon-based fire protection is in use

Building maintenance

* 1 credit for planned maintenance of the building's fabric
* 1 credit for planned maintenance of the building's services

LOCAL ISSUES

Legionnaires' disease

* 1 credit for a management system which identifies and ensures regular maintenance and treatment of the building's cooling tower(s)

Noise

* 1 credit for a timed cut-off on burglar alarms with keyholder backup

INDOOR ISSUES

Lighting

* 1 credit for a planned programme of luminaire cleaning and lamp replacement

Air quality

* 1 credit for a policy aimed at avoiding health hazards arising from passive smoking
* 1 credit for a maintenance policy which ensures regular filter replacement
* 1 credit for measured carbon dioxide levels of less than 800 parts per million in selected spaces

Hazardous materials

* 1 credit for informing staff and contractors of the presence of asbestos in the building and suitable precautions to be taken, *or* when no asbestos is present

Legionnaires' disease

* 1 credit for having carried out a survey of the building's domestic hot water services and for having taken appropriate steps to minimise risk of legionellosis

Healthy-building indicators

* 1 credit for 30 points or more
* 2 credits for 45 points or more
* 3 credits for 60 points or more

The assessment aims to reduce undesirable effects on the environment using the best available techniques not entailing excessive cost. Some of the actions needed to improve an assessment will have an economic return amply justifying the action, eg the cost of investment in measures to achieve a reduction in carbon dioxide emission rates may be met through reduced fuel bills from heating, cooling and lighting. Overall, there is evidence that such environmental overcosts can be small[4].

It is important to recognise that the relative environmental importance of individual credits is difficult to assess. There is no pass or fail under the scheme, the issues which have and have not been addressed will be clearly indicated on the certificate. To aid the communication of results the BREEAM 4/93 certificate will include a summary of performance expressed as a single rating of **FAIR, GOOD, VERY GOOD** or **EXCELLENT**. A separate rating will be given for Part 1 and, when relevant, Part 2.

This rating is based on the achievement of a minimum number of overall credits and a separate minimum level of credits in each of the three sections (global/resources, local and indoor). Inherently some issues are not applicable to certain building types and thus the maximum number of credits available may vary from one existing office building to another. It is therefore misleading to judge the merits of the assessment simply on the number of credits achieved. The single rating of fair, good, very good or excellent, will take into account the variation in the maximum number of credits possible for the particular building being assessed. It will also reflect the balance of the building's performance across each of the three sections. A building rated 'fair' will thus have the greatest range of opportunity for environmental improvement. A rating of 'excellent' will indicate a high standard of performance across the range of impacts, although there may still be scope for further refinement.

It is not at present practicable or justifiable to assess all the issues covered on a common scale. The costs to the environment and health of occupants could in theory be assessed, for example, in monetary terms, and it would be possible to devise a weighting scheme. However, today there is not sufficient information available to carry out an objective weighting because of the difficulty in assigning an economic cost to environmental effects as diverse as the health of individuals, ozone depletion, climate warming and the future value of resources such as fossil fuels.

The assessment method will be updated periodically as new information becomes available from research now being undertaken by BRE for the Department of the Environment and by other research organisations. As legal requirements evolve, certain issues may no longer be appropriate for inclusion and may be removed.

ASSESSMENT PROCESS

Assessments are carried out by independent assessors licensed by BRE. Applications for assessment should first be directed to BRE which will put the applicant in contact with a registered assessor for the scheme.

The assessor will confirm the cost of the assessment based on the size of the building and whether or not Part 1 only or both parts of the assessment are required. Where a Part 1 assessment is requested, the assessor will arrange with the owners or occupants to carry out a survey of the building. Where Part 2 is also required, a meeting will be arranged with both the facilities manager and the office manager for the building. A checklist will be circulated outlining the information that the applicant must provide for the survey and the meeting. The occupier/building manager will be responsible for collating the relevant information.

After the survey or meeting, a provisional report and certificate will be issued, outlining those criteria which the building design and its occupants have met and those which they have not. Where the criteria have not been satisfied the report will outline any simple actions that could be taken to obtain the credit.

The owners, occupants, letting or managing agents of the building will then have an opportunity to follow up any of these actions before a final certificate and brief summary report are issued.

It is recognised that large organisations occupying many different buildings may wish to undertake assessments on their own behalf and thus a self-assessment scheme has also been set up. Assessments will be carried out as just described but using assessors employed directly by the organisation. These assessors will be required to participate in the same training scheme as the independent assessors and will also be licensed by BRE. The results of assessments carried out by self assessors will be subject to independent quality control, arranged by BRE, to ensure that assessments are being undertaken on a consistent basis.

Further information on how to apply for an assessment and on the self assessment scheme may be obtained from:

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Telephone: 0923 664462
Fax: 0923 664088

2 The effect of buildings on the environment

GLOBAL ISSUES

The construction and use of buildings probably has a greater impact on the global environment than any other human activity. The main impact is the pollution emissions which arise from burning fossil fuels in order to create the energy needed to build, operate, refurbish and demolish the building. These emissions occur either at power stations when converting fossil fuels to electricity or from sources within the building, such as boilers providing heating.

There are three main environmental effects of energy use in buildings:

- the burning of any fossil fuel leads to the production of carbon dioxide (CO_2) and so may contribute to **global warming** through the greenhouse effect. Energy use for buildings currently accounts for about 50% of the CO_2 emitted in the United Kingdom[5];
- sulphur dioxide, nitric oxide and nitrogen dioxide are emitted when fossil fuels (particularly coal and oil) are burnt, thus contributing to **acid rain** and consequent damage to the natural environment;
- extraction of fossil fuels results in the **depletion of a limited natural resource** and has its own environmental impacts.

The main use of energy for office buildings is for heating, cooling, humidification, ventilation, lighting, and office equipment such as computers. Energy is also used in construction and refurbishment, to win raw materials, to make specific products, to transport them to site, to assemble the products, and to demolish and dispose of them at the end of the building's life. For most office buildings the energy used for running the building over its lifetime is many times greater than the sum of the energy used during construction, even for very-low-energy office buildings being designed today. The embodied energy of buildings is a recognised issue but requires further research before it can be incorporated into BREEAM.

Buildings also contribute to the depletion of the ozone layer, through the use of CFCs (chlorofluorocarbons), HCFCs (hydrochlorofluorocarbons) and halons. CFCs and HCFCs are used in buildings mainly as refrigerants in air conditioning systems and as blowing agents in some foamed insulants used in the building fabric. Halons are used in the fire protection systems of some buildings.

While the total consumption of CFCs in the United Kingdom has fallen over the past few years, the proportion of the total that is used in buildings has increased significantly, to approximately 15%. Air conditioning may be used more in future if the predicted global warming through the greenhouse effect is realised.

USE OF RESOURCES

As already noted, fossil fuels are a limited natural resource. Wood is important in the global context since it is a natural renewable material. Some of the timber used in buildings is obtained from areas where forests are being harvested unsustainably, resulting in the extinction of indigenous species and the clearance of forests which would otherwise help to absorb carbon dioxide (CO_2) emissions. Wood used in buildings provides a long-term store for CO_2. Improved forestry practices can be encouraged by only specifying timber from sources where the forests are being managed sustainably.

Day-to-day consumables such as paper and glass are more likely to be recycled if suitable separation and storage provision is available.

Refurbishment, demolition and replacement of buildings and their services requires significant use of energy and resources. The need for this can be reduced by ensuring that the fabric and services are maintained with longevity in mind.

LOCAL ISSUES

Water shortages are increasing and it is therefore important to conserve water. Water is used in office buildings predominantly for WCs, urinals, washing, cleaning and in some cases for kitchens, cooling systems and showers. Measures can be taken to restrict water usage in these areas.

Where cooling towers form part of an air conditioning system and are not properly maintained, legionella bacteria can be dispersed in airborne droplets up to several hundred metres from the building with a risk of causing Legionnaires' disease.

THE INDOOR ENVIRONMENT

Buildings can have a significant influence on the health, comfort and safety of their occupants. The highest concentrations of most airborne pollutants are found indoors, where the adult population of Europe typically spends 90% of its time[6].

Many pollutants are found in the indoor environment. These include formaldehyde, wood preservatives, other volatile organic compounds (VOCs), living organisms (eg bacteria, moulds, dust mites), particulates and fibres (eg asbestos), radon, and combustion products (eg carbon monoxide).

In some office buildings the occupants experience building-related symptoms in a condition known as 'sick building syndrome'[7]. Humidifier fever can sometimes arise from the operation of the air conditioning system and its associated humidification. Legionnaires' disease and Pontiac fever can potentially arise from legionella in the domestic hot water of office buildings, although this is much less of a risk than in other building types such as hospitals and hotels where systems are more extensive and the use of showers is more widespread.

Smoking is increasingly recognised as a serious hazard with passive smoking now identified as a cause of smoking-related diseases.

Some of these issues can be dealt with satisfactorily by good ventilation. Others can be improved by effective maintenance, cleaning and by careful choice of building materials for the building fabric, furnishings and fittings.

The following sections include a fuller description of the issues and how credits are awarded.

Part 1 of the assessment: Building fabric and services

Part 1 of the assessment is intended to establish the environmental performance of the building fabric and building services. This part of the assessment can be carried out on both empty and occupied buildings.

3 Global issues and use of resources

GLOBAL WARMING: CARBON DIOXIDE EMISSIONS

Purpose

To reduce the release of carbon dioxide (CO_2) into the atmosphere as a result of energy use and thus reduce the potential for global warming. Related benefits will be to reduce acid deposition due to oxides of nitrogen and sulphur and to reduce the depletion of fossil fuel resources.

Credit requirement

* **Up to 10 credits are available based on a review of features of the building and its services which influence carbon dioxide emissions.**
* **1 credit for individual check meters for each tenant in multi-tenanted buildings.**
* **1 credit for adequate sub-metering for each tenant to enable energy monitoring.**

Method of assessment

CO_2 credit rating

Credit will be given based on a review of individual features of the building fabric and services that would be expected to influence the building's energy use and hence carbon dioxide emissions. These features will be identified as part of a survey of the building by the assessors and, where appropriate, through discussions with those responsible for operating and maintaining the building.

Each feature is assigned a number of points relating to the reduction in carbon dioxide emissions that could be expected as a result of its presence. These savings have been calculated using the Electricity Association's computer program ESICHECK. Tables have been prepared for different building types and services systems, which identify the savings that are likely to result from a particular feature compared with a 'base-case building' without that feature. The assessment will cover: insulation levels, type of glazing, installed lighting loads, the type of lighting control, type of boilers or alternative heat sources, the type of air conditioning, the heating and air conditioning controls, the type of hot water system and, if applicable, the type of humidification.

Different building types with different building services systems have different base-case emission figures and different options for reducing those emissions. For example condenser heat recovery equipment can be installed in an air-conditioned building but would not be applicable to a naturally ventilated building. The relative effect of a particular feature may also differ from one building type to another, for example improved lighting controls would be expected to have less effect in narrow-plan buildings with highly glazed facades than they would in deep-plan buildings with very little daylighting.

To determine the level of emission of a building, the total number of points associated with each of the individual features identified by the survey will be added up and subtracted from the base-case figure.

The total number of points is then compared with the target figures shown below to obtain the number of credits achieved:

- 1 credit for less than 120 points
- 2 credits for less than 110 points
- 3 credits for less than 100 points
- 4 credits for less than 90 points
- 5 credits for less than 80 points
- 6 credits for less than 70 points
- 7 credits for less than 60 points
- 8 credits for less than 50 points
- 9 credits for less than 40 points
- 10 credits for less than 35 points

An example of how the assessment works is given in Appendix B.

The scale of credits is related to the absolute level of carbon dioxide that is likely to be emitted annually per square metre of office space as a result of energy use in the building. All office types are assessed against this common scale. Air-conditioned buildings which inherently require additional energy for refrigeration, humidification and fans to move the air, would typically not be expected to obtain as many credits as naturally or mechanically ventilated buildings.

Although air-conditioned buildings would not be expected to achieve the maximum number of credits, the potential scope for reducing the CO_2 emissions associated with these buildings is greater than that for naturally ventilated buildings, as shown in Figure 1.

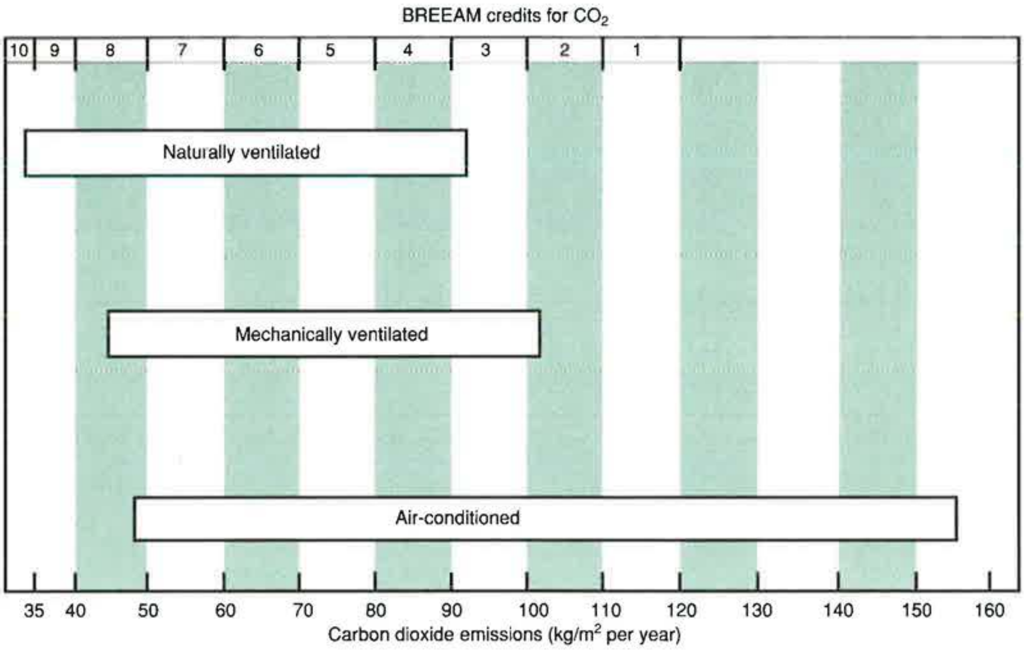

Figure 1 Range of carbon dioxide emissions from offices with different fabric and services specifications

Metering

Where the building is multi-tenanted or is being let with the expectation of more than one tenant, 1 credit will be given if separate check meters are provided to each of the tenants, so that they have knowledge and control of their fuel bills. Where buildings are single-occupancy this credit will be marked not applicable.

Where buildings have a significant energy demand, sub-metering of particular items will allow more precise monitoring and control of energy use and help to identify where savings may be made. Where tenants occupy an area exceeding 1000 m^2 they are likely to have annual fuel bills of over £5000, and 1 credit will be given if accessible meters and sub-meters have been provided where appropriate. Sub-meters should be provided for whichever are the main energy uses from the following list:

- Lighting
- Space heating
- Water heating
- Small power
- Fan power
- Refrigeration
- Catering kitchens
- Steam humidification
- Special areas such as computer suites

In smaller buildings where the total annual fuel bill is likely to be less than £5000/year, sub-metering may not be cost-effective and money may be better invested in energy conserving measures. Where fuel bills are available and indicate annual costs of less than £5000 or where offices are less than 1000 m^2 in area, this credit will be marked not applicable unless the occupants have chosen to install sub-meters, in which case the credit will be awarded.

Background

The greenhouse effect is caused by trace gases in the atmosphere which absorb and re-emit a proportion of the infra-red radiation emitted by the earth's surface, leading to a warming of the lower atmosphere. This effect is not new and without it the oceans and land would freeze. The cause for concern is an increase in the greenhouse effect, due to increasing levels of greenhouse gases, which are predominantly carbon dioxide, methane and nitrous oxide. The atmospheric concentration of carbon dioxide alone has increased from 310 parts per million volume (ppmv) in the 1960s to 355 ppmv today, an increase of more than 10% in less than 30 years. It is now increasing at a rate of about 1.8 ppmv or 0.5% per year[8]. In the United Kingdom (UK), 50% of the CO_2 emissions arising from man's activities are a result of energy use in occupied buildings[5].

Since BREEAM focuses on the environment it is appropriate to concentrate on the reduction in carbon dioxide production rather than the consumption of delivered energy. Delivered energy does not directly reflect carbon dioxide production because carbon dioxide production per unit of energy delivered depends on the fuel used. Table 2 shows the carbon dioxide emissions for alternative fuels in kg/kWh delivered.

The figure for electricity given in Table 2 is based on the current mix of fuel used for electricity generation in the UK. Over the life of the building, the mix of fuel may change and thus these figures will need to be reviewed and if necessary the targets adjusted.

Table 2 Relationship between fuel use and carbon dioxide emissions in the UK (based on the *Digest of UK energy statistics 1992*[9])

Fuel	Carbon dioxide emission (kg/kWh delivered)
Electricity	0.72
Solid fuel	0.34
Fuel oil	0.29
Gas	0.21

Carbon dioxide production is related to the amount and type of fuel consumed. The amount of fuel in turn relates to the performance of the building fabric, the efficiency of the services installations, operation and management of the building. Using less energy will also tend to reduce emissions of oxides of nitrogen (NO_x) and oxides of sulphur (SO_x), the magnitude of these reductions again being dependent on the mix of fuel employed.

CO_2 credit rating

The most satisfactory way to encourage reductions in carbon dioxide emissions would be to set a scale of targets based on the overall carbon dioxide emission for offices. This would require a validated energy consumption model for the energy performance of the office which covers the whole range of systems in use. Such a model is used for BREEAM/New

Offices: Version 1/93[1]. Much of the data required to utilise this model will not be readily available for most existing offices and furthermore obtaining and using such data where they exist is a costly, time-consuming operation. This approach is therefore not used in BREEAM 4/93. Credits are instead based on a review of individual measures that reduce carbon dioxide emissions, which are already included or could readily be included in the building.

In order to determine the relative number of points to be awarded for a given feature of the building, the Electricity Association's computer program ESICHECK has been used to calculate the likely carbon dioxide savings that would result from introducing energy-efficient features, such as good lighting control and condensing boilers. Where it would be practical to change an option in an existing building and where it shows a reasonable saving it has been included in a series of tables relating to different building types.

For air-conditioned buildings, the measures and their effects can depend on the type of air conditioning system installed, and thus assessors have separate tables covering the most common air conditioning systems such as four-pipe fan-coil, variable air volume, etc. In the course of carrying out assessments, when systems are encountered which do not fall readily into these categories, ESICHECK will be used to develop an appropriate point-score table and credits awarded accordingly.

It is important to recognise that in practice the degree to which a feature such as a condensing boiler will affect energy consumption, will be interrelated with other features of the building. For example a poorly insulated building will have a higher heat demand than a well insulated building, and thus the absolute saving that will arise from a more efficient boiler will be higher.

The assessors' tables present a simplified approach where this interrelationship has not been taken into account and a single representative figure is assigned to each feature.

Metering
Meters are normally installed for the following purposes:

1 Main meters for the entire building or site, normally for utilities to bill their customers.

2 Sub-meters for landlords to charge their tenants.

3 Sub-meters for occupiers to monitor their own fuel use: both as a whole and for individual areas or cost centres, functions, or items of equipment.

Meters should be accessible for the intended purpose, either directly or via remote-reading devices. Poorly located sub-meters tend not to be read. For example, if tenants' meters are difficult to get to, landlords may instead divide the bills according to floor area, removing the incentive for individual tenants to select and operate equipment to conserve energy. A good location for one user may not be so for another: for instance a mains meter, necessarily at the site boundary for easy access by visiting meter readers, may be too distant for regular checking by occupants.

Gas, oil and electricity supplies for heating, domestic hot water and catering kitchens (serving over, say, 100 hot meals per day) should be separately metered where appropriate. Lifts should be metered in buildings over 10 000 m^2 in floor area and over six storeys high. Escalators should be metered if there are five or more present.

Sub-metering for gas, oil or electricity would normally be justified for supplies to any area, system, group or item of equipment which uses over £1000 worth of fuel per year (typically 20 000 kWh of electricity, 70 000 kWh of gas or 7500 litres of oil). For heat meters hard-and-fast rules are more difficult to apply, but supplies costing over £5000 per year will certainly justify sub-metering, particularly where the usage is localised and exceptional, for example computer-room air conditioning served from a central chilled water system.

Where catering equipment is provided, separate metering will allow building managers to identify fuel bills as a separate item in their contract with caterers, thus providing an incentive for energy conservation in this area.

Hours-run meters are not an acceptable alternative, even for nominally constant-load devices, as they cannot identify where an item is running but has developed a fault which can cause increased energy consumption.

ACID RAIN: OXIDES OF NITROGEN

Purpose

To reduce the release of oxides of nitrogen (NO_X) into the atmosphere and thus reduce their contribution to acid deposition.

Credit requirement

*** 1 credit given where the boilers supplying the main heating load are of the low-NO_X-emitting type with burner emissions of less than 200 mg/kWh of fuel consumed, when running at full-load output.**

Method of assessment

The make and model number of the boilers and their burners will be identified during a survey of the building. Where manufacturers' test data are available to show compliance with the above emission rate, a credit will be given. A list of acceptable low-NO_X-emitting burner types will be established by the assessors and updated when new models are identified. Where no gas boilers are installed no credit will be given as other heat sources are likely to have greater NO_X emissions associated with them.

Background

NO_X is the collective term for the oxides of nitrogen emitted from heat generators during the combustion of fossil fuels.

In a standard atmospheric gas burner, nitrogen combines with oxygen in the high temperature core of the flame to produce NO (nitric oxide). This quickly oxidises further to form NO_2 (nitrogen dioxide). The mixture of these and other oxides is known as NO_X. The rate of NO_X production depends on burner design.

NO_X or SO_X (oxides of sulphur) are the major components in acid rain. Acid rain and dry deposition damage ecological systems and lead to the decay of buildings. The UK is a net exporter of acid rain while other countries, eg Holland, Denmark and Norway, are net importers. This section focuses on NO_X rather than SO_X because NO_X is always generated by the combustion process but SO_X is produced only where the fuel (particularly coal and oil) contains sulphur. Natural gas contains very little sulphur.

The main sources of NO_X emissions in the UK are power generation (30%), road transport (48%) and domestic boilers (3%), the remainder being made up of other sources such as non-domestic boilers, trains and aircraft[10].

Standard boilers emit between 260 and 400 mg of NO_X per kWh, with the smaller-output boilers generally producing the greater emission per kWh. Condensing boilers are better than conventional boilers because they reduce energy consumption by about 20% and hence reduce carbon dioxide and NO_X emissions by a similar amount.

Boiler manufacturers, in the absence of legislation, have decided to limit NO_X emissions from some of their products to a level which adds about 10–15% to the boiler price. This is perceived as a marketable overcost and the improvement is adequate to meet existing voluntary standards such as the German Blue Angel standard.

Where a low-NO_X burner is used in a condensing boiler, the combined overcost of improvements in efficiency and in reduced NO_X can be recovered from energy savings. However, some parts of the market are choosing the low-NO_X option on environmental grounds alone. At the present time, low-NO_X boilers account for about 10% of non-domestic boiler sales, with a rising trend.

The maintenance requirement of both conventional and low-NO_X burners is similar and minimal comprising an annual check and clean. With a low-NO_X boiler, more burners are needed, which may slightly increase maintenance costs.

OZONE DEPLETION: CFCs, HCFCs AND HALONS

Purpose

To reduce the release of CFCs (chlorofluorocarbons), HCFCs (hydrochlorofluorocarbons) and halons into the atmosphere and thus reduce damage to the earth's stratospheric ozone layer.

Credit requirement

- **1 credit where either no air conditioning is installed OR where the refrigerants employed in the air conditioning have an ozone depletion potential of less than 0.06.**
- **1 further credit where either no air conditioning is installed OR where the refrigerants employed in the air conditioning have an ozone depletion potential of zero.**
- **1 credit where a comprehensive automatic refrigerant detection system has been installed to detect leaks from refrigeration plant OR where no air conditioning has been installed.**
- **1 credit where a fixed or portable refrigerant recovery unit is provided permanently on site for systems with a refrigerant charge of greater than 15 kg in weight OR where no air conditioning has been installed.**
- **1 credit where there are no halon-based fixed or portable fire protection systems within the building.**

Method of assessment

Refrigerants

Where air conditioning systems have been installed the refrigerant for the system will be identified. Where the refrigerant has an ozone depletion potential (ODP) of less than 0.06 a credit will be awarded, where the ODP is less than 0.03 two credits will be awarded, and where the ODP is zero three credits will be achieved. Buildings without air conditioning would also obtain three credits. Where several systems employing different refrigerants have been installed, the credits will be based on the worst case.

Where most of the building is naturally ventilated and air conditioning is only installed to serve a particular load, such as a computer room, the building will be considered not to be air-conditioned if the net area being served by the system is less than 5% of the net floor area of the building.

Leak detection systems

A survey of the building will reveal whether or not automatic refrigerant detection systems have been installed. 1 credit will be given where sensors have been installed to sample the air at various points around the refrigeration system with the specific aim of detecting small refrigerant leaks. The sensors should be situated in the main compressor housing, in ducts carrying refrigeration pipework and adjacent to the condensers. The sensors should be linked to alarm signals in the plant room and preferably the reception area and designed to trigger the alarm when refrigerant gases are detected. The intention of the system must be to detect leaks and therefore the sensors will need to be set to raise an alarm at refrigerant concentrations lower than those considered to be hazardous to health.

Refrigerant recovery equipment

A survey of the building will reveal the quantity of refrigerant contained within the refrigeration systems. Where the total weight contained within any single system exceeds 15 kg, refrigerant recovery must be available on site for use during maintenance.

The recovery equipment should consist of either a fixed or a portable recovery unit with suitable connections to match the valves on the refrigeration system. Portable refrigerant storage cylinders must also be provided, with sufficient capacity to hold the full refrigerant charge from the largest refrigeration circuit. These cylinders should be correctly labelled to match the refrigerant in the system.

Where no air conditioning has been installed the credit will automatically be given. Where air conditioning is present but the weight of refrigerant is less than 15 kg, the credit will be marked not applicable.

Halon fire protection

A survey of the building will reveal whether or not halon fire protection systems have been installed.

These may take the form of either hand-held extinguishers or fixed fire protection systems serving, for example, computer rooms or electricity board switch rooms. Where any halon fire protection system has been provided, no credit will be given.

Note: The term air-conditioned used in this text refers both to comfort cooling and air conditioning, and thus any system where refrigeration plant is used to temper air which is subsequently distributed around the building will be covered.

Background

General background and alternatives

Chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) and halons are chemical compounds identified as being a cause of damage to the earth's stratospheric ozone layer.

The full implications of the depletion of the ozone layer are unclear but the following have all been postulated: increased ultra-violet component in sunlight reaching the earth, causing increases in human skin cancer and cataracts; reduced crop yields and damage to trees; damage to aquatic organisms; and an increased rate of degradation of certain building materials and paints.

In 1987 many of the world's governments signed an agreement in Montreal to reduce emissions of CFCs and halons into the atmosphere. This agreement (the Montreal Protocol) has subsequently been reviewed and the current requirement is that signatories will cease production of CFCs by 1 January 1996 and halons by 1 January 1994. Within Europe a European Community regulation[11] has brought forward the phase-out date for CFCs to 1 January 1995 and implemented the Montreal Protocol phase-out date for halons.

HCFCs are also controlled by the Montreal Protocol. A freeze will be placed on their consumption in 1996 based on 3.1% of the calculated level of CFC consumption plus the total HCFC consumption in 1989. This consumption will then be reduced in stages over the following years and phased out totally by 2030. A European Community regulation will require accelerated phase-out. In addition, HCFC use should be limited to those applications where other more environmentally suitable alternative substances or technologies are not available and only where CFCs and HCFCs were used previously. The European Community plans to control uses of HCFCs.

The term ozone depletion potential (ODP) provides a relative scale of damage that a particular chemical will inflict on the ozone layer — the larger the number the greater the risk. CFC11 has an ODP of 1 and is the most damaging of the CFCs. Table 3 shows alternative refrigerants and their ozone depletion potentials.

CFCs and HCFCs are used in buildings for refrigeration systems in air conditioning and as blowing agents for some foamed plastic insulation materials.

Refrigerants

In the UK most air conditioning systems have traditionally relied on CFC11, CFC12 and HCFC22, although CFC114 and CFC500 have been used in some cases. Of these HCFC22 has the lowest ODP. Over its life in the atmosphere it is estimated to be twenty times less damaging to the ozone layer than the fully halogenated CFC11 and CFC12. While at present the use of HCFC22 is preferable to the other refrigerants mentioned above, it still has a significant effect on the ozone layer and thus where possible non-ozone-depleting alternatives should be used.

Alternative refrigerants with low or zero ozone depletion potentials are currently being developed. HFCs (hydrofluorocarbons) contain no chlorine atoms and are thus thought to have no effect on the ozone layer. HFC134a is already in commercial production and is a possible alternative for CFC12. A possible alternative for CFC11 is HCFC123 which has an ODP of 0.014. However, this can only be seen as a short- to medium-term solution as it is now covered by the Montreal Protocol and will be phased out at the same time as HCFC22. There are also concerns regarding the toxicity of HCFC123. A possible longer-term replacement for HCFC22 is a combination of HFC32 and HFC134a. However, this is not yet available commercially and HFC32 has not yet completed industry toxicity tests. It is unlikely that any of these will be direct 'drop in' replacements and some modification or replacement of equipment may be required, depending on its age and type.

Apart from the development of new alternative refrigerants, there are existing refrigeration systems that avoid ozone-depleting chemicals. These include ammonia- and hydrocarbon-based systems and lithium bromide absorption chillers. While these and the HFCs mentioned above are thought to have no effect on the ozone layer, some may be potentially hazardous in other ways (eg toxicity and flammability) and thus their release to the atmosphere should also be minimised by recovery equipment and leak detection.

Refrigerant recovery and leak detection

Of the CFCs emitted from air conditioning units in the UK, it is estimated that 80% of the emissions occur during service of the equipment and through leakage whilst in normal use. Only 20% occur during manufacture and disposal[12]. Large reductions in emissions can therefore be achieved by good installation practice, effective use of leak detection systems, by making regular leak checks and by refrigerant recovery during maintenance.

Refrigerant detectors linked to alarms and ventilation fans have commonly been used in buildings to detect and respond to concentrations of refrigerant that may be hazardous to health. British Standard BS 4434:1989[13] recommends that refrigerant detectors are provided in machinery rooms where equipment such as pumps and compressors are housed. The principal aim of such equipment is to protect the health and well-being of the occupants of the building. While large leaks may be detected by such equipment smaller leaks may go unnoticed, particularly where the plant room is well ventilated.

There is therefore considerable advantage in installing a more comprehensive system of refrigerant detectors with the specific purpose of sensing smaller leaks. These will need to be triggered at lower refrigerant concentrations than those recommended in British Standard BS 4434 and will need to be positioned in those areas where a leak is most likely to occur or be detected. One method is to install air sampling lines to specific parts of the refrigeration system such as the compressor housing. These can then be linked to a sensor which is in turn linked to an alarm in the plant room and, preferably, in the reception area. Equipment manufacturers will be able to give guidance on suitable locations for refrigerant detectors. The complexity of the system will depend on the type of air conditioning installed. Systems such as Variable Refrigerant Volume, which have long runs of refrigerant pipework, will probably require a greater number of sensing points than others. Apart from the use of automatic refrigerant detection equipment, leaks may also be detected by regular inspection using hand-held refrigerant detectors. This aspect of leak detection is covered in Part 2.

Common practice in the past has been to vent refrigerant off to the atmosphere during maintenance and this practice

Table 3 Properties of CFCs, HCFCs, HFCs, halons, ammonia and propane

Substance	Formula	Montreal Protocol	Ozone depletion potential (CFC11=1)	Global warming potential (CO_2=1)	Atmospheric lifetime (years)	Flammability	Toxicity testing complete
CFC11	CCl_3F	Y	1.0	1500	60	No	Y
CFC12	CCl_2F_2	Y	1.0	4500	120	No	Y
HCFC22	$CHClF_2$	Y	0.05	510	15	No	Y
HFC32	CH_2F_2	N	0	220	6	Yes	1995/6
CFC113	CCl_2FCClF_2	Y	0.8	2100	90	No	Y
CFC114	$CClF_2CClF_2$	Y	1.0	5500	200	No	Y
CFC115	$CClF_2CF_3$	Y	0.6	7400	400	No	Y
HCFC123	$CHCl_2CF_3$	Y	0.014	29	2	No	1992/3
HCFC124	$CHClFCF_3$	Y	0.017	150	7	No	1994/5
HFC125	CHF_2CF_3	N	0	860	28	No	1994/5
HFC134a	CF_3CH_2F	N	0	420	16	No	1992/3
HCFC141b	CH_3CCl_2F	Y	0.08	150	8	Yes	1992/3
HCFC142b	CH_3CClF_2	Y	0.06	540	19	Yes	Y
HFC143a	CF_3CH_3	N	0	1000	41	Yes	Not started
HFC152a	CH_3CHF_2	N	0	47	2	Yes	Y
CFC500	CFC12/ HFC152a	Y	0.74	3333	?	No	Y
CFC502	HCFC22/ CFC115	Y	0.33	4038	?	No	Y
Ammonia	NH_3	N	0	0	<1	Yes	Y
Propane	$CH_3CH_2CH_3$	N	0	3	<1	Yes	Y
Halon 1211	CF_2ClBr	Y	3.0	Not yet measured	25	No	Y
Halon 1301	CF_3Br	Y	10.0	5800	110	No	Y
Halon 2402	$C_2F_4Br_2$	Y	6.0	Not yet measured	28	No	Y

Notes

Global warming and ozone depletion potentials are per unit mass, and values are current best available estimates which may be subject to revision. Global warming potentials relate to the long-term (500-year) warming potential.

CFC	chlorofluorocarbon.
HFC	hydrofluorocarbon (contains no chlorine so has zero ozone depletion potential).
HCFC	hydrochlorofluorocarbon or hydrogenated CFC (has a low ozone depletion potential).
HFA	hydrofluoroalkane (wider chemical group for HFCs and HCFCs).
Halon	halogenated hydrocarbon fire-fighting agent (all contain bromine so have high ozone depletion potentials).

should now cease. In most cases when refrigerant is removed from equipment, during servicing, maintenance or decommissioning, it becomes controlled waste. Section 34 of the Environment Protection Act 1990[14] places a duty of care[15] on all those who handle controlled wastes. Section 33 of the Act makes it illegal to 'treat, keep or dispose of controlled waste in a manner likely to cause pollution to the environment or harm to human health'. Also relevant are The Controlled Waste Regulations 1992[16]. In many cases access to plant rooms is difficult and refrigerant recovery equipment may be cumbersome. In order to enable compliance with this legislation, on-site refrigerant recovery equipment will be a significant benefit.

Halons
Halons have traditionally been used in buildings for fire protection systems both in fixed electrical installations such as computer suites and electricity board switch gear, and in hand-held fire extinguishers. Unfortunately, they are potent ozone destroyers. Halon 1211 (or BCF), whose characteristics make it most suitable for use in hand-held equipment, has an ODP of approximately 3, while halon 1301 (or BTM), which is best suited for use in fixed equipment in manned areas, has an ODP of approximately 10. The Montreal Protocol requires a production phase-out for halons by 1 January 1994 (except for limited 'essential' uses). Thus any fire protection equipment relying on the use of halons is likely to have a limited life and may need replacing.

For new fire-fighting equipment, alternatives to halons should be specified where possible. In most building applications, suitable alternatives such as water spray, carbon dioxide, foam and powder are available.

CFCs and HCFCs in thermal insulants
The BREEAM schemes for new offices, superstores and homes all give credits for avoiding insulation materials which contain CFCs or HCFCs. As these schemes are assessed at the design stage it is possible to determine whether or not the materials specified meet this criterion or not. For existing buildings information may not be available on the original materials specified. The manufacturing processes for insulation materials are also constantly being improved, for example polyurethane insulation was previously manufactured using CFCs but is now in some cases manufactured using carbon dioxide as the blowing agent. Even where the generic type of material could be identified from a survey, it would be difficult to determine with certainty whether or not its manufacture involved CFCs. Even where materials could be identified, a credit for this item might have an adverse environmental impact by encouraging building owners to replace CFC-containing materials simply to earn a credit. For these reasons no credit is given here. However, where new insulation materials are specified, for example as part of a refurbishment, they should not contain CFCs or HCFCs and this is covered in Chapter 6 under environmental purchasing policy. Guidance on the CFC content of insulation materials is given in BRE Digest 358[17].

RECYCLING OF MATERIALS

Purpose

To reduce energy consumption during manufacture, to reduce pressure on landfill sites, and to help to preserve non-renewable resources by promoting recycling of waste materials.

Credit requirement

*** 1 credit for buildings which incorporate separate storage facilities for recyclable materials.**

Method of assessment

A survey of the building will reveal if separate storage facilities for recyclable materials have been provided. These should have a floor area of 2 m^2 per 1000 m^2 of office space. Where buildings are more than 5000 m^2 in area, a minimum of 10 m^2 will be sufficient for a credit. The store should be partitioned from the conventional refuse area and should be clearly labelled as storage space for recyclable materials. It should be enclosed and protected from weather and should ideally be situated to allow easy access for collection vehicles and for use by the occupants. It should also have adequate fire protection.

Background

Offices generate vast quantities of waste paper including computer paper, letterhead, photocopying and note paper, much of which could be recycled. Many local authorities, private operators and environmental groups such as Friends of the Earth now operate recycling schemes. In order to make these schemes worthwhile both environmentally and financially, it is essential that a reasonable quantity of paper is collected before a collection is made. The fewer trips that are needed the lower the energy requirement for transportation and the lower the staff costs.

Unless suitable separate storage space is provided, the accumulated paper could become unsightly or present a fire hazard, thus discouraging continued participation in the scheme. Furthermore, if paper for recycling is stored adjacent to conventional refuse, it may inadvertently be removed during the conventional refuse collection. A separate designated area for storage will help to avoid these problems.

Recycling paper does not directly save trees. Almost all the virgin pulp for the paper and board products we use comes from managed plantations of pine, spruce, birch and eucalyptus, where trees are farmed for paper production. However, many of these plantations supplying timber for the UK market are in countries such as Sweden, Finland and Norway and thus considerable energy is consumed in transporting the timber to the mill. A further concern expressed by environmental pressure groups is that native forests and the wildlife they support are being cleared to make way for faster-growing monocultures, which are unable to support the same diversity of species.

In the UK we currently dispose of 90% of our waste on landfill sites. In large urban conurbations the capacity of these sites is gradually being exhausted and it is therefore important to reduce the amount of waste requiring disposal. Furthermore paper which is disposed of on landfill sites decomposes forming methane which is a powerful greenhouse gas contributing to global warming.

Apart from waste paper, other materials can be collected for recycling. These include: photocopier toner cartridges, glass and plastic bottles, metal cans, plastic cups, and batteries, both rechargeable and disposable.

4 Local issues

WATER CONSERVATION

Purpose

To reduce wastage of water, which is a valuable resource.

Credit requirement

* **1 credit for a building which has installed two of the following three water economy measures:**
  - **water meter;**
  - **WCs with a maximum 6-litre flush;**
  - **water economy devices fitted to urinals.**
* **1 further credit for a building which has all three water economy measures installed.**

Method of assessment

These items will be identified by a survey of the building and checked against a list of economy devices held by the assessment team.

Background

Water is an increasingly scarce resource with an associated increasing degree of financial and environmental cost from the development of new resources. Model Water Byelaw 76[18] states that from 1/1/93 all new WCs, in non-domestic dwelling installations, must be fitted with a single-flush cistern designed or adapted to flush no more than 7.5 litres. The installation of new dual-flush WCs is prohibited from 1/1/93: in some situations these can require double-flushes resulting in the use of over 9 litres of water. A well designed WC suite can operate efficiently at a capacity as low as 3.5 litres, and 6 litres is easily achievable.

The automatic flushing of urinals on a continuous basis (24 hours a day, 7 days a week) is common. Many devices exist for achieving reduction in consumption, including devices which flush only when the urinal is used. Alternatively, timers, occupancy sensors and water pressure fluctuation detectors can restrict the period when automatic flushing operates.

LEGIONNAIRES' DISEASE ARISING FROM WET COOLING TOWERS

Purpose

To avoid the use of systems which may present a risk of legionellosis if not properly maintained.

Credit requirement

* **1 credit for a building which has no evaporative cooling towers or condensers.**

Method of assessment

A survey of the building will reveal whether or not wet cooling towers are installed and credit given accordingly.

Background

Legionnaires' disease is a rare form of pneumonia caused by the bacterium *Legionella pneumophila*. In recent years around 300 cases of Legionnaires' disease have been reported each year. Of these approximately 12% have proved fatal[19]. These deaths result from the poor design, operation and maintenance of building services including wet cooling towers.

Legionella pneumophila is one species of a genus of bacteria known as legionella. Other species of the genus have also been linked to illness in human beings[19]. Legionella organisms are widespread both in natural water sources and in the water services of buildings. In itself the bacterium is harmless and cases of Legionnaires' disease only result from a particular chain of events. First the legionella organism must have an opportunity to multiply to a dangerous concentration, for which a water temperature of 25–45°C is favourable. It must then become airborne in an aerosol with a droplet size that can be breathed deep into the lungs. Finally, the strain must be virulent, the dose sufficient and the human host susceptible to infection.

Cooling towers and evaporative condensers are potential breeding grounds for legionella, as their temperature is ideal for growth. The fact that water is poured or sprayed over the filler pack also generates water spray, and it is this spray that has been the cause of a number of outbreaks.

The Health and Safety Commission's Approved Code of Practice[20] gives practical guidance on the requirements of the Health and Safety at Work etc Act 1974[21] and the Control of Substances Hazardous to Health Regulations 1988 with regard to the risk of legionellosis. The code does not address the technical aspects of controlling the risk. Guidance on the technical aspects of assessing and minimising the risk of exposure to legionella is given in the Health and Safety Executive publication *The control of legionellosis including Legionnaires' disease*[19] and in CIBSE technical memorandum TM13[22].

TRANSPORT

Purpose

To reduce pollution generated by cars and other vehicles by promoting the use of cycling and public transport.

Credit requirement

* **1 credit for buildings with access to good public transport.**
* **1 credit for buildings which include at least two of the following:**
  - **adequate secure points for locking bicycles adjacent to the building;**
  - **secure points which are sheltered from rain and snow;**
  - **changing facilities for staff who cycle;**
  - **facilities for hanging and drying wet clothes;**
  - **showers for staff who cycle.**

Method of assessment

Good access to public transport is defined as at least one bus stop, tram stop, train or underground station within 500 metres of the office; the service must have a minimum frequency of 15 minutes during rush-hour periods.

A survey of the building will reveal which facilities are available for cyclists and credit will be awarded accordingly.

Background

Exhaust fumes from cars contain volatile organic compounds: some of these are known carcinogens while others contribute to photochemical smog by assisting in the rapid formation of ozone in the atmosphere. The exhaust fumes also contain CO_2, NO_x and SO_2 which contribute to a variety of environmental problems.

The transport sector as a whole accounts for 25% of the carbon dioxide emitted in the UK[9] and thus has a significant effect on global warming. A daily journey totalling as little as 6 miles by car can, over the year, emit as much CO_2 as that emitted to provide heat, light and power for a person in the office.

Apart from the health effects of traffic fumes, motor vehicles also generate noise, which can be a nuisance in built-up areas and prevent people from being able to open windows. This in turn leads to a greater need for air conditioning. Congestion also creates unsightly, unpleasant and potentially dangerous environments for pedestrians and cyclists.

The widespread use of public transport and bicycles in place of motor vehicles would reduce all of these environmental problems.

5 Indoor issues

Indoor issues include all those aspects of a building design, operation and fittings, such as lighting, air quality and hazardous materials, which have an impact on the health, comfort or well-being of the occupants.

LIGHTING

Purpose

To reduce eyestrain and headaches.

Credit requirement

* **1 credit for the use of high-frequency ballasts for fluorescent luminaires and other discharge lamps in areas where people are working.**

Method of assessment

The operating frequency of the fluorescent lighting will be assessed during a survey of the building.

Background

Excessively high artificial lighting levels greatly increase energy consumption in offices, particularly when air conditioning is used. Often a large proportion of the cooling load is to compensate for the heat from artificial lighting. In some offices the lighting is the main component of the energy bill. Energy consumption due to artificial lighting is dealt with in the part of the BREEAM assessment that covers the carbon dioxide emission (see section on global warming in Chapter 3).

Headaches and eyestrain have been reduced in offices when high-frequency ballasts have been substituted for conventional ballasts used in fluorescent lights[23]. High-frequency ballasts also reduce energy consumption and cooling load, and extend lamp life producing a return on their extra cost. A range of compact fluorescent lamps with high-frequency ballasts is becoming available as direct replacements for tungsten lamps.

There are other factors which will affect the visual comfort of the occupants. These include glare, contrast and overall lighting levels. Most offices now have visual display units and are thus subject to the Health and Safety (Display Screen Equipment) Regulations 1992[24]. These require that satisfactory lighting conditions are provided and hence these issues are not covered here.

AIR QUALITY

Purpose

To achieve satisfactory indoor air quality.

Credit requirement

- **1 credit for openable windows throughout the building, which can be finely controlled or supplemented by trickle ventilation OR for effective mechanical ventilation where there is no visible free-standing water in the duct work.**
- **1 credit where humidification has been avoided OR for humidification by steam.**
- **1 credit for a filtration system which:**
  - **is capable of removing particles as small as pollen (98% of particles greater than 15 micrometres) from incoming air;**
  - **is fitted with a condition monitoring device to indicate when the filters should be changed;**
  - **has no visible gaps allowing air to bypass the filter.**

Method of assessment

Free-standing water may occur in air conditioning ductwork where the system has been badly designed or maintained. Particular areas where this is likely to occur are in the condensate drip trays of cooler coils and downstream from humidifiers. As part of the building survey, the central air-handling plant and a representative sample of terminal units will be examined for any visible signs of moisture. Where it is not possible to gain access to areas where water may accumulate, no credit can be given.

During a survey of the building the facilities manager will be asked to provide details of the filters used in any mechanical ventilation equipment, and the filter housing will be examined. Credit will be given if the above criteria have been satisfied. This will require filters of a standard at least equivalent to Eurovent grade EU5[25]. Where the building is naturally ventilated, this credit will be marked not achieved.

Background

Ventilation

There are many pollutants present in the indoor air of most office buildings arising from materials used in the building fabric and building services and also from the activities of the occupants. For most buildings the only practical way of limiting the airborne concentration of the pollutants in an existing building is by dilution with fresh air from outside the building. The alternative of stripping-out all materials, furnishings, furniture and carpets and preventing the use of certain office products known to emit hazardous substances is not usually feasible.

Where controllable openable windows are present these are under occupant control, and this is the means of providing and controlling fresh air preferred by most office occupants. However, it is important to make provision for fresh air in winter-time when windows may be closed and fresh air is only provided by air infiltration through the fabric and window frames. Fresh air may be provided in winter by trickle vents, mechanical ventilation or finely controllable windows.

Where mechanical ventilation or air conditioning is used it is important that the ventilation system does not introduce additional hazards due to duct contamination by viable organisms such as bacteria and fungi. Duct cleanliness and the absence of free-standing water are therefore essential.

Humidification

This section is based on HSE Specialist Inspectors' Report No 11[26].

Control of work-place humidity may be necessary for a number of reasons. High humidity can cause discomfort, especially at increased temperatures, and may result in excessive condensation. Low humidity causes drying of the body's mucous membranes resulting in eye and nose discomfort and in increased risk of respiratory illnesses. Static electricity becomes a problem at lower humidities. CIBSE recommends[27] a relative humidity range of 40 to 70%.

Air which is drawn into buildings from outside and then heated to room temperature often has a low humidity. It may be necessary to increase humidity for comfort and health. If the humidifier is allowed to become contaminated with micro-organisms and distribute water droplets, it may itself become a health hazard. Inhalation of contaminated water from humidifiers can cause various illnesses including respiratory infections and allergenic illness. Of these, humidifier fever, sometimes known as 'Monday sickness' is the most common.

Cases of humidifier fever in the UK have presented symptoms similar to those of influenza — aching limbs, fever, headache, chest tightness and breathing difficulty. Symptoms usually occur some hours after first exposure, then abate over the next day or so even if exposure continues. If exposure ceases for a period and then recurs, symptoms will reappear. The onset of illness on Mondays, after the weekend break, gives the illness its name.

Other illnesses caused by the inhalation of contaminated droplets from humidifiers include infections and allergies such as asthma. This is more common in the USA than in the UK.

Spray humidification is sometimes used in association with air conditioning in offices. This usually involves spraying water into the airstream as fine droplets with any surplus water falling into a tray beneath the spray heads for recirculation and respraying.

Steam humidification, usually electrically driven, avoids the use of drip trays. Free water drops are usually not present unless condensation takes place downstream of the injection point. In general, steam humidification has not been associated with humidifier fever. There is also evidence that symptoms of sick building syndrome are sometimes reduced when steam rather than spray humidification is used.

Filtration

Air quality is one of the main considerations when an air conditioning system is designed in which filtration is widely used. Filters range from a prefilter, capable of capturing only the very large particles, to those having an efficiency approaching 100%.

The two most important characteristics of a filter are filter life and efficiency. Filter life is a measure of the dust-holding capacity of the filter and efficiency is a measure of the ability of the filter to remove particulate matter from an airstream.

Manufacturers normally classify their filters according to tests given in British Standard BS 6540:Part 1:1985[28] and Eurovent 4/5[25].

Asthma and rhinitis, common chronic airway diseases responsible for widespread illness, are often caused by exposure to allergens. Two important indoor allergens are excrement from the house dust mite (1.5–0.5 micrometres in diameter) and spores from fungi (17–10 micrometres in diameter). Pollens (50–20 micrometres in diameter) are a major cause of hay fever. Many hay fever sufferers develop pollen asthma. For reasonable protection from pollens, filters complying with Eurovent grade EU5 are needed.

Air filters, whatever their design or efficiency rating, require regular maintenance (cleaning for some and replacement for most). As filters load up with particles, they become more efficient at particle removal but the airflow through them steadily reduces. This usually means that the outdoor air supply to the building also reduces. Indicators are available to help staff to determine when filters need replacing or cleaning. The indicators are inexpensive and they give an immediate and unambiguous indication of filter condition without having to open units or actually observe the filter. These may typically be a dial gauge or manometer which measures the pressure drop across the filter.

Experience has shown that poor maintenance often occurs because of difficulty of access to the various components (eg in places requiring ladders for access, or where access doors are inconvenient or are located too close to other equipment). The survey will draw attention to areas of concern where working spaces are less than specified by BSRIA[29]. Depending on access arrangements, visual examination of the filter compartment and filter will be carried out to determine if unfiltered air is bypassing the filter for any of the following reasons:

Loose filter supports
Overloaded filters
Wrong-sized filters

In heating, ventilating and air conditioning systems with acoustical duct liners or other porous materials, a visual examination of the lining will be carried out to determine if removal is necessary.

The filtration measures recommended above apply to the central air-handling plant only. Dust may also enter the building in other ways, for example by internal generation and infiltration, but these routes have not been addressed here.

HAZARDOUS MATERIALS

Purpose

To minimise health risks resulting from the presence of materials potentially hazardous to health.

Credit requirement

- **1 credit for having carried out a full asbestos survey, keeping a written record of the location of all asbestos, and taking appropriate action to deal with all asbestos identified OR where the original building specification specifically excluded the use of asbestos in the building.**
- **1 credit where there are no visible lead pipes in the drinking-water supply.**

Method of assessment

Asbestos

Where the owners or letting agents are able to provide a copy of the original specification for the building and where it specifically excludes the use of asbestos and asbestos-based products, a credit will be given.

Where this is not the case, the owners or letting agents for the building will be required to provide records of any past survey of asbestos in the building. Where a full professional survey has been carried out and appropriate decisions and any necessary actions have been taken, a credit will be given.

Appropriate action will depend on the nature and condition of the asbestos identified, as described in full in *Asbestos materials in buildings*[30]. The owners or letting agents must have the results of the survey available to pass to future occupants, enabling them to implement both of the following:

- a system of management which would provide information when asbestos may be encountered in the future, for example when maintenance work is being considered, **AND**
- a system of review to assess the need for action at this time.

The management of asbestos materials is assessed under Part 2.

Lead pipes

A survey of the building will reveal whether or not lead pipes are visible in the drinking-water supply and a credit awarded accordingly.

Background

Asbestos
The use of blue asbestos (crocidolite), brown asbestos (amosite) and products containing them is now prohibited in the UK. With certain specific exceptions the use of products containing white asbestos (chrysotile) is permitted. Today most white asbestos is used in asbestos–cement products, and in friction materials.

Asbestos is a proven human carcinogen. Exposure to high levels of airborne white asbestos fibres in the work-place, as were generated in asbestos manufacturing in the past, can cause lung cancer. The risk of lung cancer from exposure to the very low levels of airborne fibres typically found in buildings is extremely small. It has been estimated[31] to be of the order of 1 in 100 000 to 1 in a million. However, as there is no known threshold level for exposure to asbestos below which there is no risk, it is prudent to reduce exposure to the minimum that is reasonably practicable.

In general, fibres are not released unless asbestos materials are disturbed or damaged; undisturbed materials in good condition present little risk. The potential for fibre release must be assessed after making a survey, taking account of:

- the type of material and its properties, and the type of asbestos it contains;
- the integrity of the material, and the condition of any sealant or enclosure;
- the position of the material, including its accessibility and vulnerability to damage, and the use of the area of building where the material is installed.

An assessment of risk of exposure of employees to asbestos dust should be made and the appropriate action taken. The options are normally that the asbestos should be:

- left in place without sealant, but managed by an agreed system;
- left in place but sealed or enclosed and managed by an agreed system;
- removed and safely disposed of.

As part of an agreed management system, the presence of an asbestos material should be noted on plans or other records and updated as necessary. The asbestos material left in place must also be re-inspected periodically to ensure that the condition of the material has not changed. Before any maintenance or builders' works, the asbestos management records should be consulted to establish whether or not asbestos materials will be encountered. If asbestos materials are to be involved, current best practice should be used in dealing with it.

The management, sealing, enclosure, removal and safe disposal of asbestos are described in *Asbestos materials in buildings*[30].

Lead pipes

In areas where lead water-pipes and lead plumbing are common, lead in drinking water can contribute significantly to lead intake.

Proposed changes to World Health Organisation (WHO) Standards on lead in drinking water, are likely to reduce the existing recommended limit from 50 micrograms per litre to 10 micrograms per litre. The change has been prompted by renewed concern regarding lead poisoning in young children. The revised standards are due for publication in mid-1993.

The 10-microgram standard is intended to allow all children to keep their weekly intake of lead below 25 micrograms per kilogram of their body weight. The limit assumes that children receive up to 50% of their lead intake from tap water. While children are more at risk from lead intake than adults, it would seem prudent to restrict the levels of lead accumulated by both adults and children.

The degree to which water will dissolve lead from pipes and solder joints is termed 'plumbosolvency'. The plumbosolvency of water will vary from one region to another. Typically more lead is dissolved in soft waters than in hard. However, some hard waters may still be plumbosolvent.

In 1991 the drinking water inspectorate found that 3% of tap water samples exceeded the existing WHO limit of 50 micrograms per litre. In order to meet the new 10-microgram limit it is likely that lead pipes will need to be removed.

Although complete removal of lead pipes will significantly reduce lead intake from water, it will not eliminate it. While the use of lead-based pipes and lead-based solders is now restricted by water by-laws, they may still be present in many older buildings.

RADON

Purpose

To minimise the potential risk to health arising from exposure to radon.

Credit requirement

*** 1 credit for having undertaken a radon assessment in the ground floor or basement, and for having taken appropriate action where the levels were shown to be in excess of 200 Bq/m^3 OR for buildings which are outside a designated high-risk area.**

Method of assessment

The results of any radon assessment will be examined. Where the levels measured are less than a half of the 400 Bq/m^3 required by the legislation for offices, a credit will be awarded. Where they are greater than this, credit will only be given if it can be demonstrated that appropriate measures have been taken to reduce the levels below 200 Bq/m^3.

Background

Exposure to radon is subject to The Ionising Radiation Regulations 1985[32] made under the Health and Safety at Work etc Act[21]. Employers with offices situated in areas affected by radon are required to demonstrate that they have taken steps to determine the risk from radon to their employees and, where appropriate, that adequate remedial measures have been taken.

Radon is a colourless, odourless, naturally occurring, radioactive gas which originates in the ground. It undergoes radioactive decay, producing products which if inhaled increase the risk of developing lung cancer, depending on the radon concentration and the duration of the exposure.

The regions most affected by radon are the counties of Cornwall, Devon and Northamptonshire together with parts of Derbyshire, Somerset, Grampian and the Highlands of Scotland. Increased levels have also been found in small pockets in other areas. The areas affected by radon are listed by parish in a BRE Report[33].

Surveys in buildings have shown that high radon levels can be found in rooms with low ventilation rates.

Inexpensive surveys can be carried out by leaving integrating dosemeters in the rooms of interest, and the names of organisations able to supply the dosemeters and analyse the results can be obtained from local Health and Safety Executive offices.

The Ionising Radiation Regulations 1985[32] require remedial action to be taken when the levels of radon in commercial buildings exceed 400 Bq/m^3. The requirement for remedial action in homes is a half of this value because the period of exposure is roughly twice that of the work-place. However, the risk from radon is not eliminated by achieving the legislative standard. Achieving the BREEAM credit for office buildings will further reduce the risk.

INDOOR NOISE

Purpose

To achieve a satisfactory noise climate.

Credit requirement

*** 1 credit for noise levels at or below the following values:**

- **45 dB $L_{Aeq,T}$ in private offices, small conference rooms;**
- **50 dB $L_{Aeq,T}$ in large offices.**

Method of assessment

Measurements will be made using an integrating sound-level meter with an 'A' weighting, the instrument will be of type 2 or better in accordance with British Standard BS 6698:1986[34]. Where the predominant noise is steady (eg from a ventilation system) the measuring period will be 1 minute; where the noise fluctuates (eg from traffic noise) the measuring period will be 5 minutes. Measurements will be carried out under normal operating conditions. When windows are required for ventilation they will be left open during the measuring period. Permanent installations such as mechanical ventilation will be left running, but office equipment such as photocopiers will be switched off. Where office staff are present during the assessment they will be asked to be silent. Measurements will be carried out at the ear height of the occupants.

Measurements will be taken in a sample of typical offices around the building. Where, for example, there is a significant difference in noise exposure on different facades the assessment will be based on the worst case. Attention will be drawn in the accompanying report to any problem areas observed.

Background

$L_{Aeq,T}$ is the 'equivalent steady noise level' of a fluctuating noise, ie a logarithmic average of the A-weighted level over the period *T*.

Noise is a frequent cause of complaint in office buildings and can be distracting. However, in open-plan areas low noise levels can result in a lack of acoustic privacy and a balance must be struck.

The credited noise levels are based on the maximum intrusive noise levels used for building design given in British Standard BS 8233:1987[35]. The limited evidence available suggests that these levels are not yet widely met.

LEGIONNAIRES' DISEASE ARISING FROM DOMESTIC HOT WATER SYSTEMS

Purpose

To minimise the risk of legionellosis resulting from the building's domestic hot water system.

Credit requirement

* **1 credit for buildings which incorporate point-of-use water heaters for all hot water supplies to basins OR which have a secondary circulation system where measures have been taken to prevent stratification in the hot water calorifier and which is fitted with trace heating for dead-legs.**

Method of assessment

A survey of the building's services will reveal whether or not hot water is supplied from a secondary circulation system or by point-of-use water heaters. Where point-of-use water heaters have been provided and are capable of heating water to between 50 and 60°C, credit will be given. Where a secondary circulation system is used credit will be given where measures have been taken to prevent stratification of the calorifier and where dead-legs have been avoided or equipped with trace heating. The system should again be capable of maintaining water temperatures of between 50 and 60°C. Care should be taken to ensure that delivery temperatures avoid the risk of scalding.

Background

The first report of the Badenoch inquiry into the outbreak of Legionnaires' disease at Stafford[36] points out that the majority of outbreaks of Legionnaires' disease are associated with the domestic hot water systems of non-domestic buildings.

Point-of-use water heaters provide a means of reducing the incidence of legionella infections. They avoid storage, minimise dead-legs and can heat water to the temperature at which *Legionella* is destroyed. The Health and Safety Executive publication *The control of legionellosis including Legionnaires' disease*[19] gives guidance on methods of avoiding stratification and attaining acceptable temperatures in the hot water distribution pipework where secondary circulation systems are installed.

General background to this issue and useful references are given in Chapter 4 in the section on Legionnaires' disease. The risk assessment of water services as a whole is covered in Chapter 9 in the section on Legionnaires' disease.

Part 2 of the assessment: Building operation and management

The aim of Part 2 of BREEAM for existing offices is to identify how effectively the occupants are operating and managing the building with regard to its impact on the environment. Unlike Part 1, this section of the assessment is not applicable to an empty building.

6 Company environmental policy

OVERALL ENVIRONMENTAL POLICY

Purpose

To promote business practices which incorporate an awareness of the need to protect the world's environment.

Credit requirement

* **1 credit for having an established overall company policy to minimise the effect of the company's activities on the environment, and in particular the impact of the company's buildings. This should be published or openly available to clients and staff.**

Method of assessment

The occupants of the building will be required to provide a copy of the company's overall policy with regard to the environment.

Where such a document has been produced and the company is able to demonstrate that it is readily available to both staff and clients, a credit will be given.

Background

For a company to be successful in addressing environmental issues it should set clear objectives at a high management level, which can then be implemented through suitable management systems. British Standard BS 7750:1992[37] sets out guidelines designed to enable organisations to establish an effective environmental management system. The Energy Efficiency Office provides a sample energy management policy in Section 11 of GIR 12[38].

The Department of the Environment has recently launched an initiative seeking companies to make a 'corporate commitment' to energy efficiency. The key aim is to secure top management commitment to energy efficiency and one of the main features of the campaign is the signing of a declaration of commitment by a chairman or chief executive.

ENVIRONMENTAL PURCHASING POLICY

Purpose

To minimise the environmental impact of the company's choice of materials or products when maintaining or refurbishing their building. The items covered affect global issues and use of resources as well as indoor issues.

Credit requirement

*** 1 credit for a purchasing policy by those responsible for managing the building and services, which excludes the use of timber from unsustainable sources for use in partitions, doors, floors, skirtings and other fittings.**

*** 1 credit for a purchasing policy by those responsible for managing the building and services, which excludes the use of all the following:**

- **insulation materials containing CFCs or HCFCs;**
- **paints containing organic solvents;**
- **lead-based paints;**
- **asbestos.**

Method of assessment

The office manager will be asked to provide details of the company's purchasing policy for timber used in the refurbishment of the office or for partitioning, doors, floors, skirting and other fixed internal fittings. Where the policy is to avoid the use of timber from unsustainable sources and sufficient information has been provided to enable the effective implementation of this policy, a credit will be given.

Details of the company's purchasing policy with respect to the other materials listed above will also be requested. If the policy is to avoid these materials and products, credit will be given.

In both cases the policy should identify acceptable products or materials for use and the names of the suppliers from which they can be obtained. It should also be included as part of the brief to the design team or contractor when any building work is being considered.

Background

Timber

Wood is a natural and renewable material. The production of wood does not require significant energy input, nor does it generate the greenhouse gases which are associated with the production of alternative materials (except when burnt or left to decompose). The active growth of young developing trees absorbs carbon dioxide, and wood in service provides a natural long-term store for it.

Virtually all softwoods and softwood-based panel products used in construction come from plantation forests or others in which harvesting practices are managed in a controlled way by a local regulating authority. Most temperate hardwoods also come from such sources, but this is not true for tropical hardwoods; only a small proportion of UK imports of tropical hardwoods are managed on a sustainable basis.

At present there is no effective timber labelling scheme in operation that attempts to quantify the environmental impact of the timber imported into the UK. It is therefore difficult, if not impossible, for end users of timber to differentiate between the environmental acceptability of one source of timber and another. The problem is made more difficult by companies who claim that the timber they are supplying is from a sustainable source, without good grounds for making such claims.

Efforts are under way by a number of organisations to introduce an independent environmental labelling scheme for timber imports with the purpose of assisting the process of specification. In the meantime, those responsible for specifying and purchasing timber should seek the best available information to establish that the timber they are using has originated from regulated and well managed sources.

Suppliers of timber and timber products should be asked if their timber has originated from a sustainable source. If they claim that it has, they should be asked to provide details of the forest area from which the particular timber species has originated and copies of the forestry policy that is being pursued in that area. For timber products such as doors, manufacturers would need to provide details confirming the source of the timber used in production. If companies are unable to provide these details, claims of sustainable production have to be ignored.

By asking timber suppliers to provide these details, timber users will be encouraging the development and earliest possible implementation of an environmental labelling scheme for timber. Once a scheme is in place, end users of timber and timber products will be better equipped to make informed choices about the timber they are buying. They will then in turn encourage trade in timber from well managed sources and provide an incentive for producer countries to adopt 'sustainable' forestry management schemes.

While furniture is outside the scope of this assessment, it is hoped that any purchasing policy which addresses the issue of deforestation, would also cover furniture.

CFC-free and HCFC-free insulation materials
As discussed in Chapter 3 in the section on ozone depletion, CFCs and HCFCs have been identified as a cause of damage to the earth's stratospheric ozone layer and thus materials which contain them should be avoided where possible.

Advice on insulation materials which contain CFCs and HCFCs and acceptable alternatives is given in BRE Digest 358[17].

Solvent-free paints
Research carried out by BRE concluded that the use of solvent-borne eggshell paints in unventilated conditions can contribute a significant health hazard[39]. Even where ventilation arrangements are provided, white spirit vapour may exceed short-term exposure limits.

Occupational exposure limits to white spirit are imposed by the Control of Substances Hazardous to Health (COSHH) Regulations 1988[40]. These limits are defined in the HSE's Guidance Note EH 40/91[41]. The long-term exposure limit for an eight-hour time-weighted average exposure is 100 parts per million (ppm) and the short-term exposure limit for any given 10-minute period is 125 ppm. Solvent levels during application will present a significant hazard to those applying the paint.

There may also be a small hazard to occupants returning to recently painted areas or to the occupants of adjacent offices during application of the paint. The use of solvent-borne paints for interior decoration of walls and other large areas should therefore be discouraged in favour of safer water-borne paints. ICI Dulux Trade has announced its intention to replace all its solvent-based paints with water-based alternatives by the year 2000 and a number of manufacturers are already producing a range of high-quality water-based paints.

Lead-based paints and primers
Lead is used in roofing, windows and paints. Under the European Directive on Marketing and Use of Dangerous Substances (EC 76/769)[42], the 8th Amendment in effect prohibits the use of lead paints in new buildings. In April 1992 this passed into UK law[43] and covers the use of decorative paints such as those containing lead sulphate and lead carbonate, but does not include lead primers such as red lead and calcium plumbate.

Asbestos
The use of blue asbestos (crocidolite), brown asbestos (amosite), and products containing them is now prohibited in the UK. The use of white asbestos (chrysotile) and products containing it is permitted although restricted. Today most white asbestos is used in asbestos–cement products and in friction materials. Asbestos is a proven human carcinogen and exposure to high levels of airborne white asbestos fibres in the work-place (in asbestos manufacturing) can cause lung cancer. The risk of lung cancer from exposure to the very low levels of airborne fibres normally found in buildings is extremely small — estimated[31] to be between 1 in 100 000 and 1 in a million. However, alternative non-asbestos fibre-reinforced materials are available.

7 *Global issues and use of resources*

GLOBAL WARMING: CARBON DIOXIDE EMISSIONS

Purpose

To reduce the release of carbon dioxide (CO_2) into the atmosphere as a result of energy use in buildings and thus reduce the rate of global warming. Related benefits will be to reduce acid deposition due to oxides of nitrogen and sulphur and to reduce the depletion of fossil fuel resources.

Credit requirement

* **1 credit for having an energy policy endorsed by the board of directors, with a suitably trained member of staff to implement it[38].**
* **1 credit for having carried out an energy audit of the building within the guidelines set out in CIBSE Applications Manual AM5 *Energy audits and surveys*[44] within the last three years.**
* **1 credit for an energy monitoring and targeting system which sets targets and quantifies savings.**
* **1 credit for an energy efficiency improvement investment budget in relation to refurbishment or to revenue savings.**
* **1 credit for having an easy-to-follow manual detailing the operating instructions and standard control settings for all services equipment which may affect the energy consumption of the building.**
* **1 credit for regular dissemination of information on energy use and means of saving energy to services system operators and occupants, including information on how staff can personally contribute to energy efficiency.**
* **1 credit for a regular system maintenance schedule which includes the following:**
  - **measurement of boiler efficiency;**
  - **proving of competence of ventilation and cooling controls;**
  - **proving of competence of heating controls and hot water controls;**
  - **identification and investigation of all occurrences of excess energy use;**
  - **all maintenance actions logged immediately in a record book or similar document.**

Method of assessment

The assessment team will interview the facilities manager or energy manager of the building using a checklist and will seek evidence from files, maintenance contract specifications log books and work sheets for action in place.

Background

The management and operation of the building services and also the way the occupants use the building can have a major impact on its energy consumption. A maximum of seven credits is achieved when energy management forms part of the organisation's environmental policy and is fully integrated into the organisation's management systems, where monitoring and targeting systems are in place based on sub-metering of the fuels used, where regular reports and reviews of the monitored data take place and where targets for energy efficiency improvements are set and supported by an action plan. Financial support for an action plan is essential, either by a budget allocation or by allocation of all or part of savings in fuel bills towards investment in energy-saving measures or guidance to users in the operation of facilities. It is also vital that an appropriate person in the organisation is responsible for energy saving.

Effective maintenance and operation of the building services can have a significant effect on energy efficiency. It will also help to prevent unexpected breakdowns and prolong the life of equipment, avoiding unnecessary use of resources in premature replacement. (This aspect of maintenance is covered later in this chapter under 'Use of resources'.) A credit is given where maintenance schedules, either in-house or under external contract, address on a regular basis boiler efficiency and the setting and operation of controls for space heating, water heating and cooling. For effective maintenance to be carried out, means of checking the results need to be in place and to be readily understandable by the organisation's management through the use of log books or record cards.

The Heating and Ventilating Contractors Association (HVCA) standard maintenance specifications for mechanical services[45] give guidance on suitable maintenance procedures to be adopted.

In order to ensure the correct operation of building services there will be considerable advantage in compiling an easy-to-follow manual, listing all the services contained within the building, giving for each a description of its function, operating instructions and the standard control settings to be adopted. Where controls require manual alteration, either daily or seasonally, the person or contractor responsible for making these adjustments should be identified and a schedule of visits arranged.

Staff awareness of the importance of energy costs and efficiency is important if efficiency is to be improved through management procedures, including the staff who are responsible for the operation and maintenance of the building and its services and also the office workers. Credit is given where dissemination of energy efficiency information is given a high profile within the organisation.

The CIBSE Applications Manual AM5 *Energy audits and surveys*[44] gives guidance on the preparation of specifications, commissioning and undertaking of energy surveys. Advice is given on how to identify and specify the requirements of an audit and site investigation, and on how to carry out an appropriate level of study and implement recommendations.

OZONE DEPLETION: CFCs, HCFCs AND HALONS

Purpose

To reduce the release of CFCs (chlorofluorocarbons), HCFCs (hydrochlorofluorocarbons) and halons into the atmosphere and thus reduce damage to the earth's stratospheric ozone layer.

Credit requirement

* **1 credit given for a maintenance agreement which has been established to ensure regular inspection for refrigerant leaks AND, if installed, where a management system is in place to deal promptly with any alarms raised by an automatic refrigerant detection system. This credit will also be given to buildings which avoid refrigeration altogether.**
* **1 credit given where a schedule of maintenance and testing of fixed halon fire protection systems has been drawn up with the specific aim of minimising unnecessary emissions of halon OR where halon-based fire protection systems are not present in the building.**

Method of assessment

Leak detection

Facilities managers will be asked to provide details of their policy on refrigerant leak detection and how it is implemented. Credit will be given if either of the following policies are being pursued:

- Where no automatic refrigerant detectors have been installed, a maintenance schedule must have been agreed with the maintenance contractor which requires a regular inspection of the refrigeration system and refrigerant pipework. This must stipulate inspections on at least a quarterly basis, provide a list of those items of equipment that are to be inspected and describe the method of inspection to be used. Anyone with access to the plant areas should also be informed of the name, address and telephone number of the company or person responsible for maintenance, so that if a leak is discovered between inspection visits, they can be contacted immediately and the necessary work carried out to rectify it.

- Where sensors have been installed to detect refrigerant escaping from the refrigeration systems and to sound an alarm automatically, the above requirements should still apply, but in addition those staff with access to areas where alarms are situated should be informed of their presence and the necessary action to be taken if an alarm is triggered. The agreement with the maintenance contractor should stipulate how quickly they would be expected to respond to an alarm and should include the requirement for the sensors and alarm system to be tested at least twice a year.

Halons

Where either hand-held or fixed halon fire protection systems are present in the building, the facilities manager will be asked to provide written details of their policy for ensuring that emissions are reduced to a minimum.

The policy provided must require that any maintenance, filling or decommissioning of the systems, is carried out in accordance with the guidelines given in British Standard BS 6535:Section 2.2:1989[46]. Testing and inspection procedures for portable fire extinguishers should be carried out according to British Standard BS 5306:Part 3:1985:Section 8.12[47]. For total flooding systems the fan pressure testing procedure set out in British Standard BS 5306:Section 5.1:1992[48] should be specified. Written agreements will need to have been drawn up with any contractor undertaking work on the system, to ensure that these requirements are being met.

Where staff are trained in the use of hand-held extinguishers, the policy should require that training does not proceed to discharge of the halon contents. The policy should also require that all halon contained within the fire protection system is recovered for recycling at the end of its life or when faulty equipment is replaced.

Background

The general background for including the credits relating to ozone depletion is given in Part 1 (Chapter 3, the section on ozone depletion). The following is relevant to this section in particular.

Leak detection

Of the CFCs emitted from air conditioning units in the UK, it is estimated that 80% of the emissions occur during service of the equipment and through leakage whilst in normal use. Only 20% occur during manufacture and disposal[12]. Large reductions in emissions can therefore be achieved by installation and effective use of leak detection systems, by making regular leak checks and by refrigerant recovery during maintenance.

As discussed in Part 1 it is now necessary to recover refrigerant during the maintenance servicing and disposal of refrigeration systems. It is assumed that facilities managers will have taken the necessary steps to meet this mandatory obligation and no credit is available for this action.

Apart from the use of automatic refrigerant sensors discussed in Part 1, leaks may also be detected by inspection. The method adopted will depend on the type of equipment installed and advice should be sought from the refrigeration contractor on the most suitable method to employ. One method is the use of marker dyes which can be added to the refrigerant and will show up as coloured marks or lines if a leak develops. These include the use of fluorescent dyes which can be detected by shining an ultra-violet lamp over the surface of the equipment. Marker dyes may not be compatible with all equipment and advice should be sought from individual suppliers about their suitability. Other methods include the use of the halide lamp, hand-held electronic refrigerant sensors, and soap solutions which will create bubbles when applied to an area where a leak is present.

Halons

British Standard BS 6535:Section 2.2:1989[46] gives guidance on procedures which can be adopted to reduce unnecessary emissions of halons when halon fire protection systems are being filled, emptied or decommissioned. These include the use of separate filling and recovery rigs to avoid contamination, leak testing of the rigs before use and in service, and leak testing of halon containers both before and after filling.

The fire-fighting industry has adopted a number of methods to minimise unnecessary emissions of halons: these include fan pressure testing of enclosures in place of discharge testing, and ensuring that training in the use of hand-held extinguishers does not proceed to discharge of the halon contents. British Standard BS 5306:Section 5.1:1992[48] includes a description of the fan test to be used instead of discharge testing to assess compartment integrity of total flooding systems.

Testing procedures for portable halon fire extinguishers are given in British Standard BS 5306:Part 3:1985[47]. Section 8.12 describes inspection and testing procedures that do not involve the discharge of any halon; Section 9 describes periodic testing and discharge.

Fixed and portable halon cylinders have a limited life. When defective or old cylinders are disposed of, they should be returned for safe disposal and recovery of the halon contents. There are a number of commercially available systems whereby halon can be safely discharged without emission to then atmosphere and recycled for future use. Such recycled halon is permitted within the Montreal Protocol.

For new fire-fighting equipment, alternatives to halons should be specified. Research is under way to identify suitable functionally similar chemical replacements. In building applications, suitable alternatives such as carbon dioxide, water spray, foam and powders are available.

USE OF RESOURCES: BUILDING MAINTENANCE

Purpose

To encourage planned maintenance of the building's fabric, services and structure, thus prolonging their life and avoiding unnecessary use of resources resulting from premature replacement or inefficient operation. Associated benefits will be to reduce the risk of health hazards resulting from poorly maintained services and structures and to improve comfort.

Credit requirement

* **1 credit where a planned programme of regular maintenance, cleaning and inspection of the building's fabric is in operation supported by a comprehensive and easy-to-follow manual.**

* **1 credit where a planned programme of regular maintenance, cleaning and inspection of the building's services is in operation supported by a comprehensive and easy-to-follow manual.**

Method of assessment

The owners or tenants of the building will be asked to provide details of their future plans for maintenance of both the building fabric and services. Where a planned programme of maintenance has been drawn up and documented in the form of an easy-to-follow manual and where it is being implemented, credits will be given.

It is expected that maintenance of the building fabric will be treated separately from that of services, and that there may be separate documents relating to each of these areas. In order for credit to be given, in each case a manual or set of documents that are easy to locate and follow, should be available. These documents should contain the following information:

Fabric maintenance

- a list of the elements of the building fabric that require maintenance, for example window frames, sealants, roof cladding and membranes, etc;
- a description of the planned maintenance procedures to be adopted for each item, including frequency of inspection and maintenance, and the name of the person or company responsible for undertaking the maintenance;

- a log book or computer system for recording and monitoring maintenance visits.

Building services

- a list of all building services equipment and control systems requiring maintenance, for example fan motors, pumps, dampers, etc;
- a description of the planned maintenance procedures to be adopted for each item of equipment, including frequency of inspection and maintenance, and the name of the person or company responsible for undertaking the maintenance;
- a log book or computer system for recording and monitoring maintenance visits.

Background

Where buildings and their services are not properly maintained, they may start to deteriorate, in extreme cases requiring major refurbishment or demolition. In such cases the process of refurbishment or reconstruction will require a large consumption of both energy and materials, thus putting an unnecessary burden on the planet's resources. Where services are inadequately maintained they may become less efficient, increasing energy consumption or presenting a health hazard to the occupants of the building. The effect of maintenance on energy efficiency is covered in the first section of this chapter.

Appropriate planned maintenance is necessary to retain a building's value as an asset, sustain utility, and to ensure compliance with legal requirements, such as health and safety regulations, and it will assist owners and occupiers to manage the building in a more efficient and hence environmentally conscious way.

It is recommended that regular building fabric and services inspections are carried out by independent professional surveyors and engineers, initially to set up and subsequently to monitor a long-term planned maintenance programme and to ensure that all maintenance will continue, to retain asset value of the building and meet the set environmental requirements.

Appropriate planned maintenance and the standard to be achieved will vary with the building type and condition. The life requirement of the building should be established as the maintenance will vary if retained in its present mode and if there is an intention to upgrade or refurbish.

Upgrading or replacement of the building's fittings and services may require the setting up of a sinking fund within the planned maintenance rolling budget.

Guidance on the management and setting up of a building maintenance programme is given in British Standard BS 8210:1986[49]. British Standard BS 7543[50] sets out a standard procedure for documenting the expected durability and hence maintenance requirements for the components of a building.

8 Local issues

LEGIONNAIRES' DISEASE ARISING FROM WET COOLING TOWERS

Purpose

To minimise the risk of legionellosis by ensuring that water services are properly treated and maintained.

Credit requirement

*** 1 credit for a management system which identifies and ensures regular maintenance and treatment of the building's cooling tower(s).**

Method of assessment

The facilities manager will be required to demonstrate that a maintenance schedule has been drawn up in line with current codes of practice and that it is being implemented. Where no cooling towers are present, this credit will also be marked not applicable.

Background

General background on the potential hazard of legionellosis is given in Part 1 (Chapter 4, the section on Legionnaires' disease). The following is particularly relevant to the operation of the building.

The Health and Safety Commission's Approved Code of Practice[20] gives practical guidance on the requirements of the Health and Safety at Work etc Act 1974[21] and the Control of Substances Hazardous to Health Regulations 1988[40] with regard to the risk of legionellosis. The Code does not address the technical aspects of controlling the risk. Guidance on the technical aspects of assessing and minimising the risk of exposure to legionella is given in the Health and Safety Executive publication *The control of legionellosis including Legionnaires'disease*[19] and in CIBSE technical memorandum TM13[22].

Although failure to comply with any provision of the Health and Safety Commission's Code is not in itself an offence, that failure may be taken by a court in criminal proceedings as proof that a person has contravened the legal requirement to which the provision relates. In such a case, however, it will be open to that person to satisfy a court that they have complied with the requirement in some other way.

NOISE FROM THE BUILDING

Purpose

To reduce noise nuisance from intruder alarms.

Credit requirement

*** 1 credit for a security alarm**

(a) either with no external audible warning device OR, where an external audible warning device is fitted, the period of sounding of the device is limited to not more than 20 minutes, AND

(b) with staff trained in the operation of the system and keyholders or security personnel appointed to respond to alarm calls during unoccupied periods.

Method of assessment

Credit will be given where the occupants of the building are able to demonstrate that their security alarms have no external audible warning device or that where such a device is fitted it has an automatic cut-off to prevent a sounding time of longer than 20 minutes. They will also be required to confirm that a system of keyholders or a security firm have been appointed to respond to any alarms raised and that suitable written procedures have been agreed.

In buildings such as banks, where security is paramount, the assessment will only require a letter of assurance from the owners of the building that the alarm system meets the above criteria, and no specific details of the system or procedures will be required by the assessor.

Background

Noise made by the operation of audible intruder alarms is a frequent cause of complaints. These relate mainly to the duration of ringing rather than to the volume of noise produced.

Alarm systems fall into two main categories: remote monitored alarm systems which are connected, for example, by telephone to a central monitoring station, or stand-alone systems known as sounder or bells-only systems. Both types may have an external audible alarm.

The government code of practice on noise from audible intruder alarms[51] recommends that in order to avoid serious disturbance to the public, it is desirable for audible intruder alarms to be fitted with an automatic cut-out device. This device should automatically stop the ringing after a period of 20 minutes from activation of the system. A cut-out device can be supplemented with a flashing light which continues to operate after automatic termination of the ringing, and indicates that the premises are still in alarm condition.

Where remote systems are installed, a security company will usually be responsible for an initial response to any alarms raised. If a criminal act is suspected the police are informed. Where bells-only systems are installed, a system of keyholders should be in place who are required to respond to any alarms raised within 20 minutes. These may be members of staff or an appointed security company.

The best way to avoid needless disturbance to the public from audible intruder alarms is by preventing false alarms. False alarms occur due to a variety of causes, including user error, faulty design, installation and equipment, and environmental factors. The largest single cause of error is due to incorrect use of the system. Compliance with British Standard BS 4737[52] will help to minimise false alarms.

Recent legislation[53] has given powers to London Local Authorities to require:

- the registration of all alarm systems in their area;
- the fitting of cut-out devices to limit external sounding time to 20 minutes;
- the registration of keyholders.

It also allows the local authority to enter premises forcibly and to switch off the system. To date, only a few local authorities have taken up these powers.

Police forces may require the registration of remote monitored systems. The police registration policy laid down by ACPO (the Association of Chief Constables)[54] requires for registration:

- the system to be installed in line with British Standard BS 4737;
- installation to be carried out by a reputable company;
- all alarm calls, except in specific circumstances, to be verified before informing the police.

It also allows the police to refuse to attend an alarm call from premises where the number of false alarm calls are excessive, and also to refuse to accept for registration any new system installed by a company who have installed systems with a bad record of false alarms.

In all cases where an automatic cut-out device is fitted it is most important for the alarm holder to inform the insurers. Failure to do so could result in failure of the claim.

9 Indoor issues

Indoor issues include all those aspects of a building design, operation and fittings, such as lighting, air quality and hazardous materials, which have an impact on the health, comfort or well-being of the occupants.

LIGHTING

Purpose

To maintain the design level of visual comfort and performance and to maintain energy efficiency.

Credit requirement

*** 1 credit for a planned programme of luminaire cleaning and lamp replacement.**

Method of assessment

The building managers will be asked to provide a planned maintenance schedule covering lamp replacement and cleaning of luminaires.

Background

A well maintained lighting installation will have clean lamps and luminaires. In addition, the lamps will be replaced at the end of their useful life, which usually will be before failure. The light output of discharge lamps, such as fluorescent tubes, decreases throughout their life while the power consumed remains constant. Their efficacy (light output per watt consumed) therefore declines.

A maintenance schedule giving details of cleaning and lamp replacement is therefore essential for a well maintained lighting installation. In most cases cleaning intervals will depend on the rate of soiling likely to occur. Air-handling luminaires generally have a lower soiling rate than non-ventilated luminaires. Recommended cleaning intervals for luminaires in offices are one or two times a year.

Lamp replacement can usefully be on a bulk replacement basis, all lamps being changed at the same time, and related to cleaning of the luminaires. If lamps are only replaced on failure, the majority of lamps in an installation become relatively old and inefficient. The period between bulk replacements will depend on the operating period with, for most office applications, replacement every 2 or 3 years. Where the spaces are predominantly daylit, longer periods may be appropriate. Lamp lumen depreciation may be less with high-frequency electronic gear.

AIR QUALITY

Purpose

To achieve satisfactory indoor air quality while maintaining energy efficiency.

Credit requirement

*** 1 credit for effective policy on passive smoking.**

*** 1 credit for maintenance schedules which ensure filter replacement when necessary.**

*** 1 credit for measured carbon dioxide levels of less than 800 parts per million in selected spaces.**

Method of assessment

Smoking policies will be reviewed with the building managers. Where sufficient ventilation has been provided to areas where smoking is permitted and they have been partitioned from non-smoking areas, credit will be given. Credit will also be given where an effective ban on smoking has been introduced.

Where air conditioning or mechanical ventilation is present in the building, the facilities manager will be asked to provide details of the maintenance schedules covering filter replacement. Where these are adequate to ensure that the filters are replaced according to manufacturers' recommendations, credit will be given.

The assessor will measure the carbon dioxide levels in spaces which will include selected offices and the plant room.

Background

Smoking

The smell from tobacco smoke causes annoyance and discomfort to many non-smokers and indeed to smokers themselves. It pervades hair, clothes and furnishings. The non-smoking majority, about 70% of the adult population[55], would largely prefer not to breathe air polluted by tobacco smoke when at work or when visiting public places.

The Department of the Environment's Code of Practice 'Smoking in public places'[55] states that 'non-smoking should be regarded as the norm in enclosed areas frequented by the public or employees, special provision being made for smokers rather than vice versa'.

Passive smoking means breathing other people's tobacco smoke. Tobacco smoke is generated whenever a cigarette, pipe or cigar is smoked, and where smoking occurs, in homes, public places or non industrial work-places, it is likely to be the major source of indoor air pollution. The so-called main-stream smoke is that which is purposely inhaled, some then being exhaled by the smoker. The side-stream smoke (which makes the main contribution to smoke in the room) comes straight from the burning tip of the cigarette, pipe or cigar.

There are two main phases (or components) of tobacco smoke: the particulate phase (small droplets of 'tar' containing nicotine) and the gas/vapour phase, containing such chemicals as carbon monoxide, nitric oxide, ammonia, hydrogen cyanide and acrolein. Tobacco smoke also contains small amounts of some substances which have been shown in laboratory tests to induce cancer in animals; these include a range of N-nitrosamines, polycyclic aromatic hydrocarbons and benzene. There are considerable differences in the concentration of some of these components between main-stream and side-stream smoke[55].

Independent scientific bodies throughout the world have concluded that passive smoking can be a significant cause of lung cancer in non-smokers. This view is based largely on results of studies of individuals whose passive exposure to tobacco smoke is frequent, prolonged and intense (eg people whose partner is a heavy smoker). In March 1988 the Independent Scientific Committee on Smoking and Health published its review of all the available scientific evidence (the Frogatt Report)[56]. It concluded that 'the findings overall are consistent with there being a small increase in the risk of lung cancer from exposure to environmental tobacco smoke, in the range of 10–30% [which] might amount to several hundred out of the current annual total of about 40 000 lung cancer deaths in the UK'. In the light of this evidence, government policy is to help to reduce people's exposure to tobacco smoke whenever possible.

The advice given by the code depends in part on the reason the public are visiting the building, but it falls into two main categories: either a complete ban on smoking, or the provision of separate smoking rooms or areas for those who wish to smoke. Where smoking is to be permitted a ventilation rate of between 24 and 32 litres/second per person should be provided. Ideally heat-recovery devices should be considered to reduce the energy penalty of these increased ventilation rates. (The recommended ventilation rate in non-smoking areas is 8 litres/second per person.) Rooms where smoking is permitted should also be physically separated from non-smoking areas by solid floor-to-ceiling partitions. Any air recirculated from smoking areas should not be recirculated to non-smoking areas.

Detailed advice on ventilation to smoking areas may be obtained from the BRE Advisory Service Hotline: Telephone 0923 664707.

Filtration

Background on filtration is given in Part 1 (Chapter 5, the section on air quality).

Ventilation

There are many pollutants present in the indoor air of most office buildings arising from materials used in the building fabric and building services and also from the activities of the occupants. One way of limiting the airborne concentration of the pollutants is by dilution with fresh air from outside the building. Where openable windows are present this is under occupant control. Where mechanical ventilation or air conditioning is used it is important that the ventilation system does not introduce additional hazards due to duct contamination by dust or viable organisms such as bacteria and fungi.

It is not possible in the survey undertaken with a BREEAM assessment to measure the fresh air input rates into occupied spaces. This is the sum of the fresh air through the windows and leaking through the fabric together with that supplied by mechanical ventilation (where the building is mechanically ventilated or air-conditioned). Instead, measurements will be made of the carbon dioxide levels in selected spaces. The increase in the carbon dioxide level above that of the ambient air outside the building depends on the rate at which carbon dioxide is put into the building by the occupants of each space, which is largely determined by the number of occupants, and the dilution of the emission by outside air. The carbon dioxide level is used as a proxy for good ventilation.

For the measurement period, the occupancy of the space will need to be at about the normal occupied level and in naturally ventilated buildings the windows will need to be closed to simulate the worst case, winter-time condition. Where observed carbon dioxide levels are high, the space will be poorly provided with fresh air and it is likely that contaminants such as organic gases and vapours will also be at high levels. The carbon dioxide level chosen for a credit is 800 ppm or less.

HAZARDOUS MATERIALS

Purpose

To reduce health risks resulting from the presence of asbestos.

Credit requirement

*** 1 credit for a system of management which provides information about the presence of asbestos and sets out an appropriate scheme for periodic monitoring and assessment, including suitable precautions to be taken when asbestos is likely to be disturbed, OR where it has been confirmed that no asbestos is present in the building.**

Method of assessment

The occupants of the building will be required to provide records of an asbestos survey together with details of their management system for dealing with its findings. The credit can only be awarded where a Part 1 credit relating to asbestos has been obtained.

Background

Background on the potential hazards associated with asbestos are given in Part 1 (Chapter 5, the section on hazardous materials).

LEGIONNAIRES' DISEASE ARISING FROM DOMESTIC HOT WATER SYSTEMS

Purpose

To minimise the risk of legionellosis resulting from the building's domestic hot water system.

Credit requirement

*** 1 credit where a risk assessment has been carried out of the building's domestic hot water services and appropriate steps have been taken to minimise the risk of legionellosis.**

Method of assessment

The facilities manager for the building will be required to demonstrate that a survey has been carried out of the building's hot water services and that appropriate action and maintenance schedules have been drawn up in line with codes of practice to minimise the risk of Legionnaires' disease.

Background

The first report of the Badenoch inquiry into the outbreak of Legionnaires' disease at Stafford[36] points out that the majority of outbreaks of Legionnaires' disease are associated with the domestic hot water systems of non-domestic buildings.

General background on legionellosis is given in Chapter 4 in the section on Legionnaires' disease.

HEALTHY-BUILDING INDICATORS

Purpose

To improve the health of office occupants by reducing their risk of experiencing the symptoms of 'sick building syndrome'[7].

Credit requirement

The risk of the occupants experiencing sick building syndrome depends on many factors associated with the building fabric, services management, maintenance and operation. A review of the factors known to be related to the risk will be made (see method of assessment below) before credits are awarded on the points scored:

* **3 credits for 60 points or more**
* **2 credits for 45 points or more**
* **1 credit for 30 points or more**

A single credit suggests that the building is healthy, ie has a lower than typical probability of the occupants experiencing sick building syndrome. Two and three credits indicate decreasing levels of risk.

Method of assessment

Risk factors have been identified which relate to the healthiness of buildings, ie to the potential for occupants to experience sick building syndrome. These include both building-related and operational aspects. Not all aspects have the same relative importance nor the same strength of evidence. A points scoring approach (see Table 4) has been developed with the number of points for each aspect related to (a) the strength of the evidence, (b) the strength of the likely effect on sick building syndrome (SBS), and (c) the notion that prevention is better than cure.

Some of the issues related to SBS are known to have adverse health effects on their own and are covered in their own right elsewhere in the BREEAM assessment. They are identified here again as one of many contributors to the points score.

Knowledge of SBS is not yet complete. A high points total cannot ensure that no SBS problems exist, particularly as it is not feasible for all relevant factors to be measured in this assessment. Not obtaining a credit does not indicate that SBS problems exist. However, it is suggested that a survey of the office occupants may be worthwhile as a follow-up to the BREEAM assessment, using an SBS questionnaire based on that used by BRE and other researchers.

Table 4 Indicators to healthy buildings: points scoring

Points	Issue
Heating, ventilating and air conditioning	
5	No air conditioning (except in computer suites, secure rooms and other special high heat load situations) and building designed to avoid overheating
3	Openable windows or mechanical ventilation with individual control
3	Air intakes (a) designed to ensure exhaust air does not re-enter, (b) located away from sources of outdoor pollution, and (c) protected by suitable filters (one point for each)
2	Steam or no humidification*
3	No recirculation of used air*
1	Recirculation with adequate particulate filtration
3	Systems designed and installed for easy maintenance and cleanliness, with filter media, thermal and acoustic insulation prevented from releasing fibres into the airstream*
3	Extract ventilation to areas used as toilets, kitchens, and for smoking, photocopying and other polluting activities
2	Occupants provided with local control of temperature, eg by thermostatic radiator valves, and, where appropriate, information on the use of these controls
3	Commissioning complete or system re-commissioned in last 5 years, including check procedure on the commissioning data*
3	All systems thoroughly cleaned before hand-over or at least within the last 5 years*
2	No collection of stagnant water or dirt within ventilation system*
Building and furnishing materials	
3	All furnishings thoroughly cleaned within the last year or shown to be clean
1	Use of non-static carpets
Lighting and solar control	
2	No tinted windows
2	Solar control blinds (external or inter-pane) on all windows orientated more southerly than NE or NW
2	Lighting able to meet CIBSE standards with provision for visual display unit work where necessary
2	Use of high-frequency ballasts for fluorescent lighting
2	Artificial lighting with local controls plus task lighting and with a view out of a window from each work station
Noise	
2	For meeting the BREEAM indoor noise requirement
Layout	
3	Cellular rather than open plan, ie at least 90% of rooms designed for 10 or fewer occupants
3	Shallow plan: maximum distance of occupants from a window of 7 m
Operation and maintenance issues	
3	Hygiene and maintenance schedule including: all air intakes checked and cleaned regularly, filters replaced, wet regions in air conditioning systems cleaned and sterilised and regular checks for and cleaning of dirt accumulations in system*
3	Operational maintenance schedule including: automatic control system (eg local thermostats), humidification units
3	Operational maintenance schedule including: control point settings, a requirement for re-commissioning on re-partitioning and a check for blocked air supply grilles*
3	Carpet cleaning specification requiring high performance, regularly maintained vacuum cleaners with high efficiency, hot water extraction (steam) cleaning (with minimum operating temperatures of 70°C) or liquid nitrogen treatment at least once a year and, where papers are stored for more than 2 years, cleaning them
3	Questionnaire-based staff survey to determine prevalence of sick building syndrome symptoms 1 year after occupation and then every 2 years
3	Policy to minimise the use of polluting processes, equipment and materials including adhesives, floor waxes, stains, polishes, spray cans, deodorisers, detergents, etc
3	Smoking ban or smoking allowed only in designated and separately ventilated rooms which make up less than 5% of the floor space
2	Lighting levels checked and light fittings cleaned on a regular basis

* Automatic credit for natural ventilation

Background

In recent years SBS has emerged as a problem not only in the UK but also in most Western industrialised countries. Sick building syndrome is defined as a group of symptoms which people experience while in the building, the primary symptoms being:

- irritated, dry or watering eyes;
- irritated, runny or blocked nose;
- dry or sore throat;
- dryness or irritation of the skin, occasionally with rash;
- less specific symptoms such as headache, lethargy, and poor concentration.

These symptoms are of course present in the population at large, but they are distinguished by being more prevalent, as a group, in some buildings in comparison with others. The term SBS is frequently applied more broadly to any building-related illness or excess of complaints about the building. This is unhelpful and confusing and it is important to be clear that SBS does *not* relate to:

- long-term effects of identified indoor hazards (eg radon, asbestos, lead, etc);
- infectious illnesses (eg Legionnaires' disease, Pontiac fever, etc).

Such problems may occur in the same building which experiences a high incidence of SBS. Similarly there may be an excess of complaints about the indoor environment but this is not enough on its own to define SBS: the symptoms must also be present.

Although neither life-threatening nor seriously disabling, SBS can be important through reduced staff efficiency, increased sickness absence, increased staff turnover and increased time spent complaining and dealing with complaints.

Many possible causes of SBS have been suggested and researched with most explanations focusing on the air quality, naturally ventilated buildings showing fewer symptoms than air-conditioned buildings. Causes have, in general, not been specifically identified but it is possible from the large number of published studies to identify 'risk factors' and avoid them. The factors forming the basis of the points scores here are thought to be the main ones[7]. They have been established through two types of study: (a) correlations where the symptoms were related to building and other features, eg more symptoms experienced in air-conditioned buildings than in naturally ventilated buildings, and (b) experiments where changes have been made to the office (where possible without the knowledge of the occupants) and a decrease in the number of symptoms has resulted, eg intensive office cleaning.

Sick building syndrome is thus at present defined, as many health problems have been in the past, in terms of symptoms and conditions of occurrence, rather than cause. The reason is that there is no single proven cause, and any attempt to introduce cause into the definition is likely to be misleading at present, particularly since there are probably multiple causes. It is nevertheless possible to undertake preventative and remedial measures, much as many diseases were to some extent prevented (eg by hygiene practices) and treated by reducing specific symptoms (eg fever) long before the cause was identified.

Although it is generally thought that SBS has multiple causes, there is a tendency to refer to single causes or classes of causes (eg air conditioning, indoor air quality) and this can be misleading, although it is of course possible that in some buildings there is a single main cause.

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Appendix A Future issues

There are many issues which are relevant to buildings and the environment which have not been included in the current version of BREEAM/Existing Offices. There are five main reasons for their exclusion:

- No clear improvement on current regulation can be identified.
- There is no firm evidence of an environmental problem.
- The problem exists but more research is required before assessment criteria can be defined.
- The assessment of the issue is not practicable at present.
- They are issues where a detailed assessment outside BREEAM may be appropriate for buildings with specific problems.

As has been explained in Chapter 1, no attempt is made in the assessment process to evaluate the effect of possible future climate changes on the building.

Global issues and use of resources

- Choice of fuel supply to minimise pollution from primary sources (ie combined heat and power, hydro, wind, energy from waste) and consequences of off-peak electricity.
- The energy content (and associated carbon dioxide emission) of building materials and life-cycle analysis.
- Energy use during maintenance and refurbishment.
- The greenhouse gases released during fuel extraction, processing and distribution, eg methane released in the ventilation of coal mines, oil extraction and gas distribution.
- Flexibility of use and choice of materials for durability.
- Additional water economy measures such as rain-water collection, spray taps, foot-control taps, etc.

Local issues

- External appearance: aesthetics, planting, landscaping, etc.
- Sunlight reflection from building facade.

Indoor issues

- Indoor physical parameters such as temperature, humidity and air velocity levels.
- Levels of volatile organic compounds.
- Levels of bacteria and fungi.

- Ventilation effectiveness.
- Daylighting.
- Glare.
- Dust-mite levels.
- Airborne dust levels.
- Fresh-air rates in individual occupied spaces.
- Infra-sound.
- Electromagnetic radiation.
- Negative ions.
- Use of plants to absorb indoor pollutants.
- Pest control.
- Healthy-building indicators for unoccupied offices.

Appendix B
Calculation of credits for carbon dioxide emissions: worked example

As explained in the section on global warming in Chapter 3, assessors will identify features of the building which will influence its energy performance as part of a survey of the building. These will be compared against a table of options for the particular building type and the likely savings identified. Table B1 shows a typical example of how the credit rating would be obtained for a deep-plan building using a four-pipe fan-coil air conditioning system.

The base-case figure of 119 kg/m^2 per year is that which is typical for a building with no insulation, single glazing, an installed lighting load of 21 W/m^2, no effort to economise on lighting use, conventional high thermal capacity boilers, a conventional full fresh-air four-pipe fan-coil system with no heat recovery devices, direct electric local water heaters and no humidification. Similar assumptions would be made for all the base-case buildings.

The building which the assessors visit is a modern building, where reasonable attention has been paid to installing efficient systems. It has insulation levels equivalent to the requirements of the 1990 Building Regulations and has clear float-glass double glazing with internal venetian blinds. The building is deep plan. To economise on artificial lighting the occupants have installed high-efficiency light fittings with high-frequency ballasts which has reduced the lighting load to 12 W/m^2. They have also installed presence detectors to ensure that lights are not left on unnecessarily. The boilers providing heating are of the high-efficiency condensing type and the air conditioning system is fitted with heat recovery from the condenser water circuit. As with the base-case building, water is provided by local electric water heaters, but unlike the base case the building is humidified to a relative humidity of 40% using steam humidifiers.

The point scores for each of these features are shown in Table B1. In most cases the building is more efficient than the base case and points are deducted from the base-case figure. However, the water system is the same as the base case and obtains no points. The presence of steam humidification increases the building's energy consumption in comparison with the base case and thus points are added.

Having subtracted and added these individual points from the base-case figure we are left with a final point score of 70. This is less than 80 and thus obtains 5 of the 10 credits possible according to the scale shown below. In order to obtain 6 credits a score of 69 would have been required.

- 1 credit for less than 120 points
- 2 credits for less than 110 points
- 3 credits for less than 100 points
- 4 credits for less than 90 points
- 5 credits for less than 80 points
- 6 credits for less than 70 points
- 7 credits for less than 60 points
- 8 credits for less than 50 points
- 9 credits for less than 40 points
- 10 credits for less than 35 points

Table B1 Credit rating for deep-plan building with four-pipe fan-coil air conditioning system

Building form: deep plan
Percentage glazing: 35%

	Points
Base-case CO_2 emission (kg/m^2 per year)	119
1 Thermal insulation	
U-values to 1990 Building Regulations	–13
2 Glazing and blinds	
Double glazing with internal blind	–5
3 Lighting	
Load (W/m^2): 12	
Type of control: Good	–22
4 Heat source	
Condensing boiler	–4
5 Air conditioning variation	
Full fresh air, with condenser heat recovery, no recirculation to the central air handling unit	–7
6 Domestic hot water	
Local direct electric (some storage)	0
7 Humidification	
Steam humidification (40% minimum relative humidity)	+2
Total point score	**70**
Credit rating	**5**

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